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EXPLOITATION OF MAMMALS AT THE EARLY BRONZE AGE SITE OF WEST ROW FEN (MILDENHALL 165), SUFFOLK, ENGLAND

SANDRA L. OLSEN
Assistant Curator, Division of Anthropology

ABSTRACT

The large assemblage of faunal material from the Early Bronze Age site of West Row Fen (Mildenhall 165) in Suffolk, England, provides important data on the economy and subsistence during a poorly known time period in Great Britain. Dominated by gracile, short-horned cattle and small, Soay-sized two-horned sheep, this primarily domestic fauna demonstrates that by this period there was minimal dependence on hunting in comparison to stock rearing. Other common domesticates in the assemblage are goats, pigs, and dogs. Wild species that were hunted include hare, red deer, roe deer, and aurochs, the latter represented by only one extremely large humerus. It is unclear whether horses at West Row Fen were domestic or wild. Preserved carnivores include the wild cat, red fox, and domestic dog. The presence of the western hedgehog, the western mole, and the water vole suggests a wet woodland habitat typical of the fens during this period.

Aging of the domestic livestock by epiphyseal fusion and dental eruption and wear show differential treatment of cattle, sheep and goats, and pigs. Cattle were probably used more for draft than for their dairy products, whereas sheep or goats were being milked. Most pigs were slaughtered in their first year of life to control population growth, although some were allowed to reach reproductive maturity and were killed as needed.

Major taphonomic processes included carnivore gnawing, sedimentary abrasion probably caused by trampling, moderately light root-etching, and, more rarely, erosion, weathering, and rodent gnawing. Butchering patterns, previously poorly known from the Bronze Age of Britain, suggest that cow horns were heavily utilized, metal axes may have been used on cattle carcasses, and dogs were eaten. Pathologies are those frequently associated with domestic animals, such as malocclusions, tooth anomalies, and bone modification caused by heavy draft. A total of 120 bone and antler artifacts were identified, including awls, a pin, a scoop, a spatula, tubular beads, a dagger, pressure-flakers, a handle, socketed mace-heads, and a wedge.

INTRODUCTION

West Row Fen contains a remarkably well-preserved Early Bronze Age village that reveals much about the lives of its inhabitants. Located in Suffolk County just west of the modern town of Mildenhall (Fig. 1), the site had been protected for centuries by an overlying cap of Iron Age peat. The fen was drained in 1759, and erosion subsequently removed much of the peat (Martin and Murphy, 1988: 353), exposing the richness of Neolithic and Bronze Age settlements in the fenlands around West Row. Although plowing has damaged and destroyed most of these prehistoric deposits, one site, Mildenhall 165, remained relatively undisturbed.

Major excavations of the site were first undertaken in 1982 and continued through 1986. The archaeological work was conducted by the Suffolk Archaeological Unit and English Heritage, under the supervision of Dr. Edward Martin. Approximately 4200 m^2 were excavated, yielding over 31,000 pieces of animal bone. All lithic and bone artifacts were recorded three-dimensionally using a reference datum, and unworked faunal material was recorded by feature, layer within a feature, or 1-m^2 unit.

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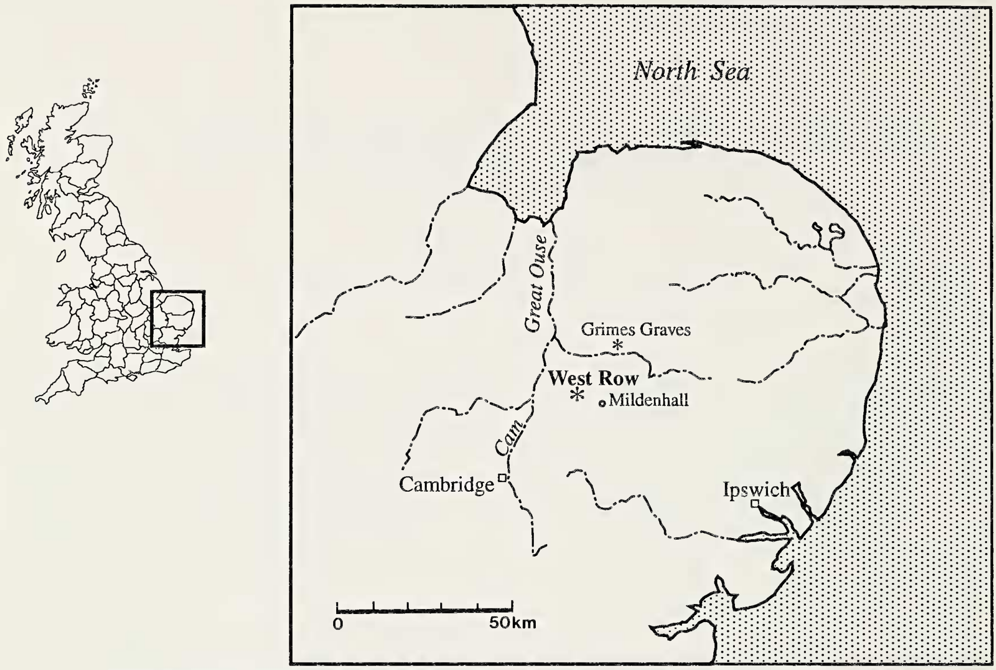

Fig. 1.—Map of East Anglia showing the location of the site of West Row Fen.

The site lies primarily on a penannular sand ridge about 2.3 m above an adjacent hollow. While some plow damage was noted on top of the sand ridge, most of the deposits were intact at lower elevations. Some of the deepest features lie below the water table and therefore contain well-preserved organic matter.

A small lithic scatter of Mesolithic age and a few Neolithic pits and lithic scatters were found, but the village dates predominantly from the latter part of the Early Bronze Age. Radiocarbon dates for the Early Bronze Age component place it at ca. 2290–1780 B.C., calibrated.

The environment in the vicinity of the site can be inferred from the preserved wood, macrobotanical remains, pollen, terrestrial mollusks, and small vertebrates. The rich woodlands surrounding the site included oaks on the higher ground and alders on lower elevations. After the village land was cleared, wet tussock conditions persisted. Scrub and wet woodland plants such as elder, hazel, holly, sloe, and willow were also present around the periphery. Cultivated plants consisted primarily of emmer wheat, accompanied by spelt wheat, hulled barley, and flax (Martin and Murphy, 1988:356).

The remains of mollusks, fish, amphibians, reptiles, and birds are still undergoing investigation by other researchers, but do not contradict environmental indications from plant remains. The microfauna from flotation and fine screening, containing numerous rodents and insectivores, is also being analyzed separately and is excluded from this study.

Portions of three round houses fabricated from light timber were found on the ridge (Fig. 2). The most complete was about 5 m in diameter and had a porch on the south-east side (Martin and Murphy, 1988:355). A midden area filled one of the lower parts of the site.

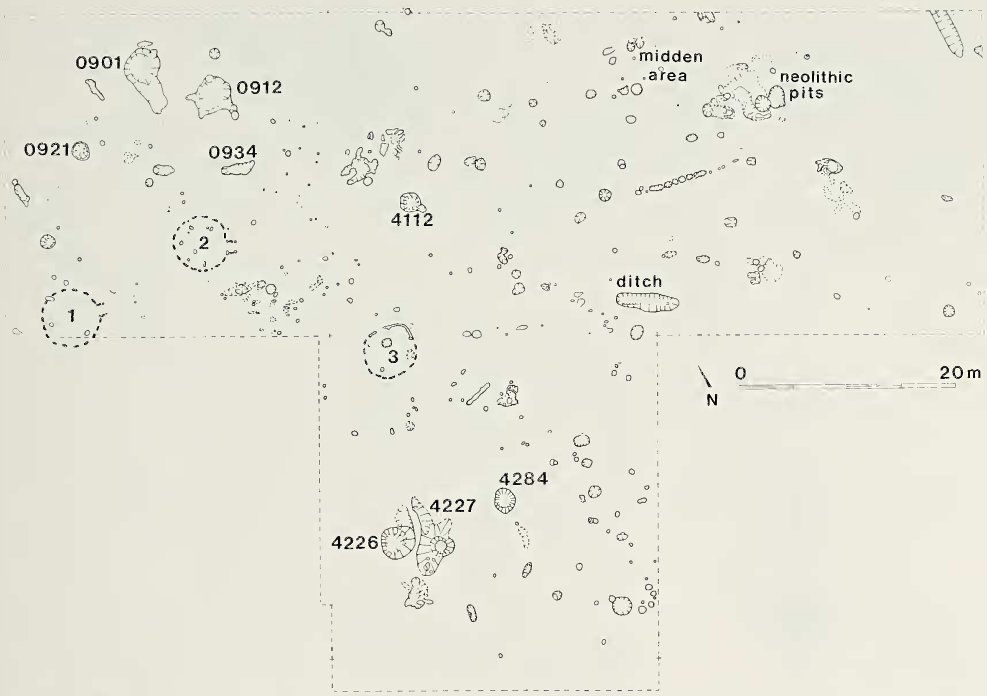

Fig. 2.—Plan of excavated area showing locations of features and houses. Key to features: 1, house; 2, house; 3, house; 0901, water pit; 0912, water pit; 0921, flax retting pit; 0934, charcoal clamp; 4112, water pit filled with ash and charcoal; 4226, large water pit; 4227, large feature containing water pit; 4284, antler soaking pit.

The most informative features were the numerous pits distributed over the site (Fig. 2). The dry pits along the ridge contained charcoal, animal bones, potsherds, flint, and other domestic debris. The wet pits (0901, 0912, 4112, 4226, 4227, and 4284) in low-lying areas of the site served several functions. Some were lined with alder logs to support the sidewalls and allow easy access, and probably functioned as shallow wells. Pit 0921 contained seeds and fragments of flax (*Linum usitatissimum*) and appears to be the oldest known retting pit in Britain (Martin and Murphy, 1988:355). Pit 4284 (diameter, 2 m; depth, 1.05 m), contained a split red deer antler (length, 42 cm) that was apparently placed in water to soak prior to undergoing further manufacturing.

The stone implements recovered include scrapers, knives, saws, borers, arrowheads, mace-heads, hammerstones, querns, and rubbing stones (Martin and Murphy, 1988:355). Seven small jet toggles, ranging from 1.3 to 2.3 cm in length, may have served as earrings or buttons. Pottery was mostly Grimston-type plain ware.

The large assemblage of mammalian fauna from West Row Fen, Mildenhall 165, documents a heavy dependence on domestic species in the Early Bronze Age with a secondary reliance on wild animals to supplement the diet. At present, few large collections from the British Bronze Age have been studied. The material from the Middle Bronze Age deposit at Grimes Graves, in Norfolk (Legge, 1981, 1992), and from the Late Bronze Age layers at Runnymede in Surrey (Done, 1991, Serjeantson, 1991) are the most notable exceptions.

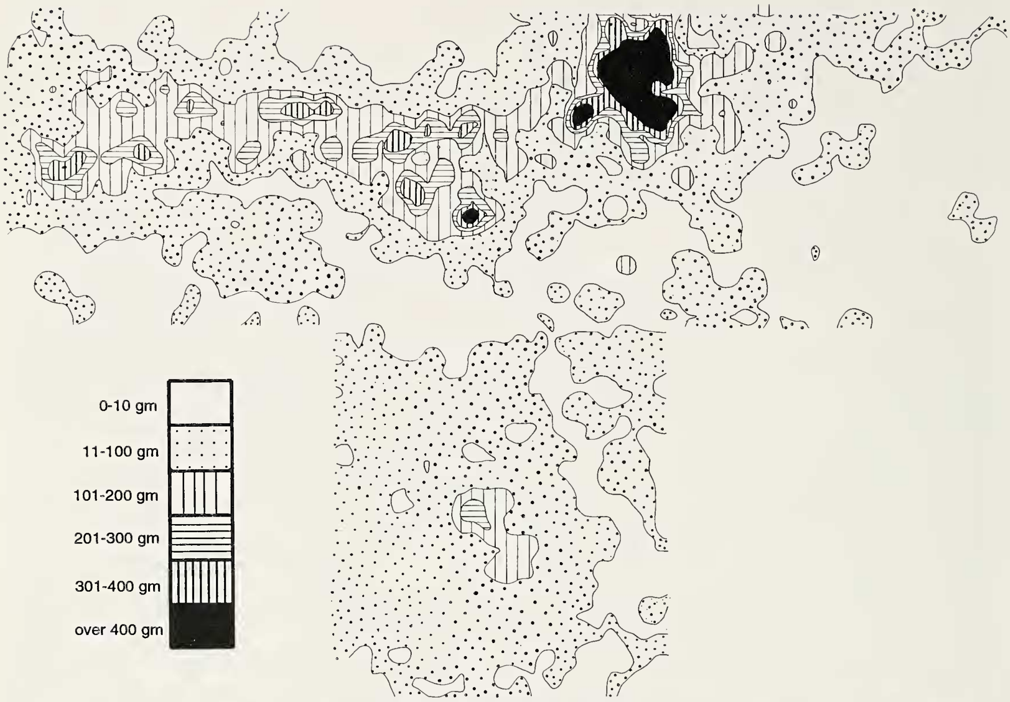

Fig. 3.—Distribution of animal bone fragments throughout the excavated area of the site.

SPATIAL DISTRIBUTION OF MAMMALIAN FAUNA IN SITE

The unmodified faunal material was distributed unevenly across the site (Fig. 3; Table 1). The densest concentrations were just west of the midden area, but the midden itself and the area around the flax-retting pit, water pits, and a charcoal clamp in the western part of the site also contained considerable amounts of animal bone. Another concentration was found during the 1985 excavations in the southern part of the site around the antler soaking pit. Three of the pits (0901, 0912, and 4226) contain large numbers of bones, suggesting that the pits were filled in with food refuse when their original function ended. The species repre-

Table 1.—*Number of identifiable bone fragments in features.*

Feature	*Canis*	*Sus*	*Capreolus*	*Cervus*	*Ovis/Capra*	*Bos*
House 1			1	3	1	1
House 2		1	1		4	4
House 3		2			3	1
Pit 0901		8	2		25	40
Pit 0912		6		1	29	70
Pit 0934						9
Pit 4112					2	1
Pit 4226	8	2		4	39	51
Pit 4227	1				2	5
Pit 4284	2			1	3	4
Neolithic pits						3
Ditch		5			2	5

Table 2.—*Frequencies of mammalian taxa from West Row Fen.*

Taxon	NISP	% of NISP[a]	MNI	% of combined MNI (175)	Individual usable meat (kg)[b]	Combined usable meat (kg)[c]
Class Mammalia	23,189	n.a.	n.a.			
Erinaceus europaeus	3	<1	2	1		
Talpa europaea	1	<1	1	1		
Lepus, cf. *L. capensis*	19	<1	3	2	2.25	6.75
Order Rodentia	10	<1	n.a.	—		
?Arvicola terrestris	14	<1	2	1		
Felis sylvestris	4	<1	1	1		
Vulpes vulpes	9	<1	1	1		
Canis familiaris	81	1	5	3	5	25
Cervus, *Bos*, or *Equus*	979	12	n.a.	—		
Order Artiodactyla	29	<1	n.a.	—		
Sus scrofa	757	9	21	12	15	315
Suborder Ruminantia	1198	14	n.a.	—		
Family Cervidae	4	<1	n.a.	—		
Capreolus capreolus	69	1	6	3	10.5	63
Cervus elaphus	139	2	5	3	95	475
Family Bovidae	25	<1	n.a.	—		
Capra hirca	6	<1	2	1		
Ovis aries	52	1	9	5		
Ovis/Capra	1617	20	60[d]	34	12.5	750
Bos primigenius	1	<1	1	1	450	450
Bos taurus	3230	39	55	31	350	19,250
Equus caballus	15	<1	1	1	300	300
Totals	31,451		175			

[a] $n = 8262$ fragments (excludes those only identifiable to Class Mammalia).
[b] Usable meat weight for an average adult individual (based on Milisauskas, 1978).
[c] Usable meat for the species is calculated by multiplying the usable meat weight per individual by the MNI for that species.
[d] MNI recalculated to combine *Ovis/Capra* (MNI = 59), *Ovis aries*, and *Capra hirca*.

sented in the pits were domesticates, red deer, and roe deer, all of which appear to have been consumed by the inhabitants. The areas in and around the houses were kept remarkably clean of animal remains. One possibly significant intraspecific concentration of bones was a cluster of eight dog bones in water pit 4226, which probably represents food refuse. Animal burials and ceremonial treatment of animal remains were not observed. Bones of wild species, such as hare, red deer, and roe deer, were scattered and distributed in the same pattern as the domestic species.

METHODOLOGY

In order to determine relative frequencies of mammalian species at West Row Fen, both the NISP (number of identified specimens) and the MNI (minimum number of individuals) were calculated (Grayson, 1979). The MNI was calculated using a zone technique, which records the portions of each bone present in detail (Dobney and Rielly, 1988). Each bone is divided into zones according to diagnostic features and the ways in which bones break most frequently. To calculate MNIs the number of times a zone appears for the left and right bones is counted separately. The zone with the largest number (for either the left or the right element) yields the MNI for that bone. The MNI for a species is the count from the bone with the highest MNI. Table 2 lists the taxa identified, followed by the NISP and

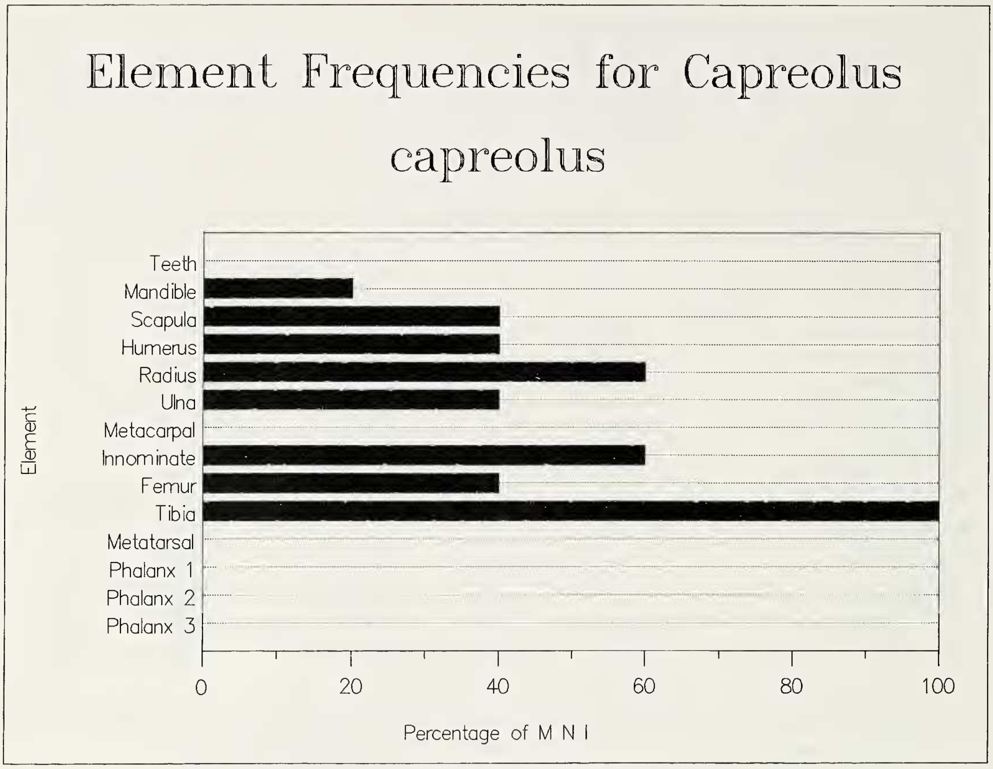

Fig. 4.—Element frequencies for *Capreolus capreolus.*

MNI for each taxon by absolute numbers and percentages of identifiable mammalian fauna (excluding those elements only identified to Class Mammalia).

Table 2 also lists the estimated weight of usable meat in each of the food-producing species. According to this measure, cattle were clearly the most important food species at West Row Fen, followed by sheep and goats, and then red deer. The single aurochs would have yielded as much meat as 36 sheep or goats. Pigs, which are third most abundant, rank fifth in meat yield. However, meat yield must be considered in a temporal context. For example, despite the enormous dietary contribution made by a single wild aurochs, it represents only one event that would provide a windfall for a few weeks or even months if the meat was smoked or dried. But aurochs and other wild game would not be as consistently available as domestic pigs. Domestic animals are "walking larders" and can provide a secure food source in periods of environmental stress when wild species cannot. Calculating the actual amount of meat consumed at West Row Fen using estimated weight of usable meat is a technique fraught with problems (Guilday, 1970) and is not attempted here.

Element frequencies (Fig. 4–8) are useful in contrasting butchering patterns and body part utilization between hunted and domestic species, especially when the hunted species are field dressed to lessen the burden of hauling home a whole carcass, and domestic species are killed near the village. This calculation pertains more to red deer than roe deer, which are easily carried back whole. There was no clear evidence of field dressing or discarding of bones of low utility in this assemblage.

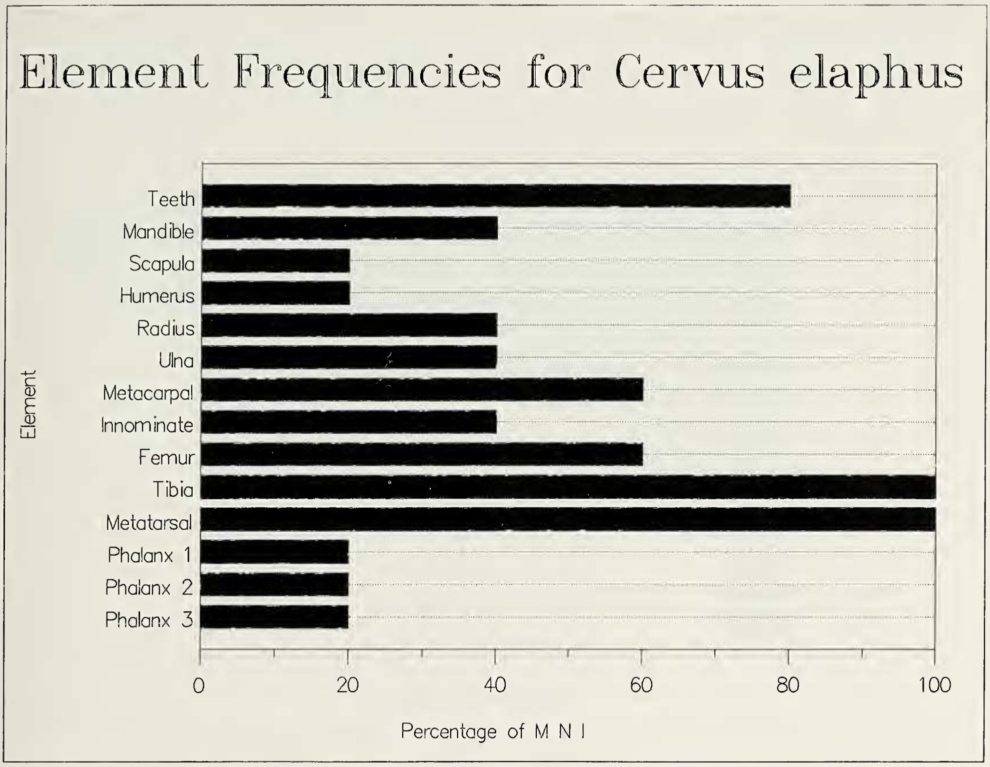

Fig. 5.—Element frequencies for *Cervus elaphus.*

Figures 4–8 imply differential preservation due to various taphonomic factors. Phalanges are poorly preserved but teeth are in abundance, implying that the low number of phalanges was caused by natural or cultural processes rather than inferior recovery techniques. Phalanges have marrow cavities and are easier to break than teeth. Dogs may have chewed on the phalanges, destroying them or leaving only undiagnostic fragments. Humans may also have reduced the phalanges beyond recognition with hammerstones while retrieving the marrow. Distal tibiae were very well-represented, probably because they are very dense and resist destruction. Flat elements constructed of thin cortical bone not bolstered with considerable amounts of cancellous tissue, like the scapula, ulna, and innominate tended to be slightly less well-preserved. These elements are susceptible to breakage during excessive pedoturbation (Olsen, 1989), such as trampling in this case.

Tooth eruption and wear stages were recorded for domestic ungulates with reference to Silver (1969), Grant (1982), Bull and Payne (1982), and Legge (1992). The absence of complete tooth rows, however, impeded reconstruction of mortality patterns for all of the species at West Row Fen. In recording the wear patterns on the teeth of *Ovis/Capra* and *Bos taurus,* Grant's (1982) technique was used, but as it requires nearly complete tooth rows, final determinations of ages were made chiefly on the basis of Silver's (1969) eruption dates and information compiled by Legge (1992). Both Bull and Payne (1982) and Silver (1969) were used to age pigs. Redding's (1981) methods for calculating percentages of animals surviving past the ages of fusion for long bones was applied to the domestic animals from West Row Fen.

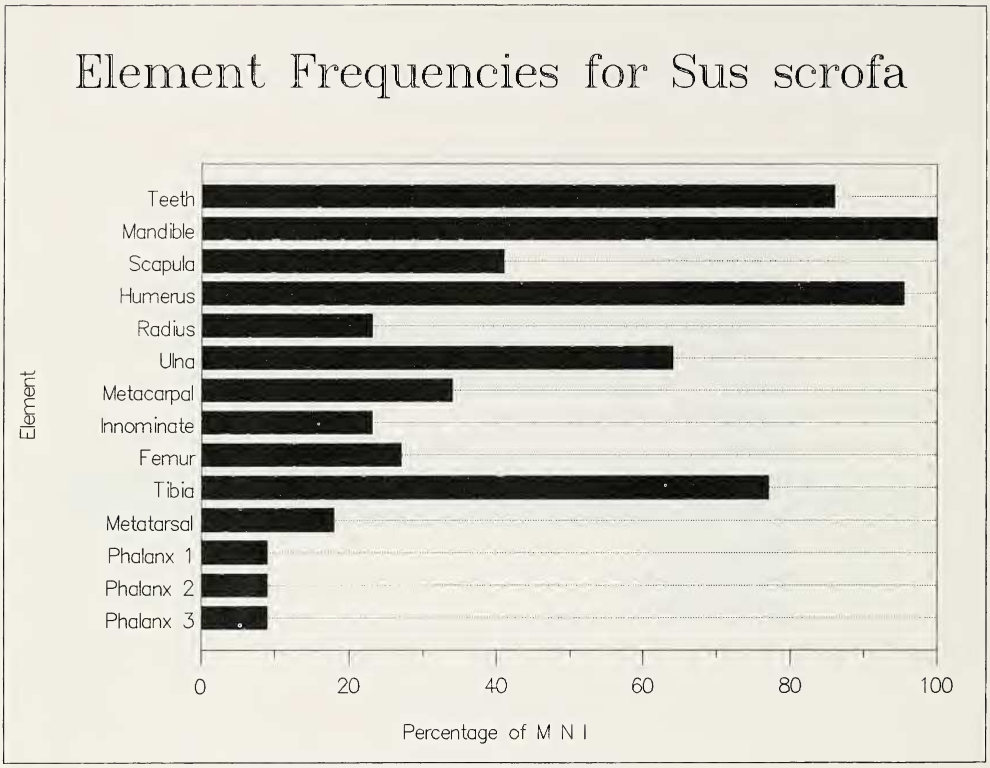

Fig. 6.—Element frequencies for *Sus scrofa.*

All fragments with butcher marks were drawn so that the orientation of each mark and the number of bones with marks in those positions could be determined. This information is summarized on illustrations of articulated skeletons for each of the three most prevalent species (Fig. 18, 20, 23). Distinctions between cutmarks, chopmarks, and scraping were noted. The best examples of each type of butcher mark were replicated by making silicone rubber molds and epoxy resin casts for examination in a scanning electron microscope.

Taphonomic traces, pathologies, and anomalies were recorded. Specific causes are difficult to attribute to pathological alterations of archaeological bone, but comparisons can be made with living individuals with known histories in order to make tentative diagnoses.

Conditions of Preservation

Soil conditions at the site of West Row Fen are typical of these fenlands and are significant regarding bone preservation. The site's location in sandy deposits resting on top of chalk provides the soil with a pH that is sufficiently alkaline for bone conservation. Although less bone survived in the overlying peat layer, the peat's acidity apparently did not filter down enough to alter the sand's pH and dissolve the bone in that layer. Sand is generally not a good medium for bone preservation because the loose grains allow water to flow through too easily, but

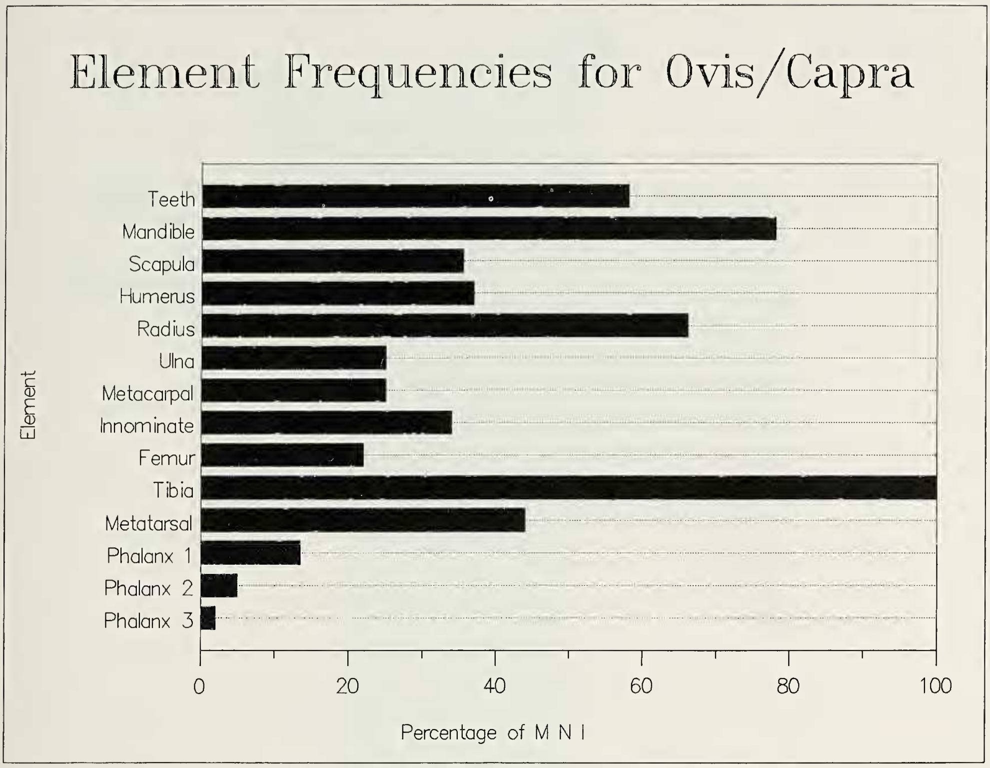

Fig. 7.—Element frequencies for *Ovis/Capra.*

in this case the chalk inhibited drainage and made the ground water alkaline enough to maintain a suitable environment for preserving bone. Mineral accretions, apparently rich in iron, were found adhering directly to some bone surfaces, but these could be removed with gentle brushing in most cases. Butcher marks as well as manufacturing and use-wear traces on bone artifacts were readily visible on the well-preserved bone surfaces.

TAPHONOMY

Despite the generally good condition of the faunal material from West Row Fen, the effects of several deleterious taphonomic agents were observed. The frequencies of taphonomic effects on identifiable bone fragments are displayed in Table 3. Of these processes, carnivore gnawing was the most destructive agent. Whole condyles of cattle bones were occasionally missing as a result of heavy gnawing (Fig. 9). Since most butcher marks occur in the epicondylar regions of long bones, many were probably destroyed as a result of carnivore activity. Carnivores probably caused impact scars and spiral fractures as often as humans, so the extent of marrow extraction by humans was difficult to assess. In this case, the most likely culprits in carnivore gnawing were the village dogs, since they are the most common carnivores in the assemblage, and foxes and wild cats were the only other carnivores identified. Because of their specialized dentition, cats rarely

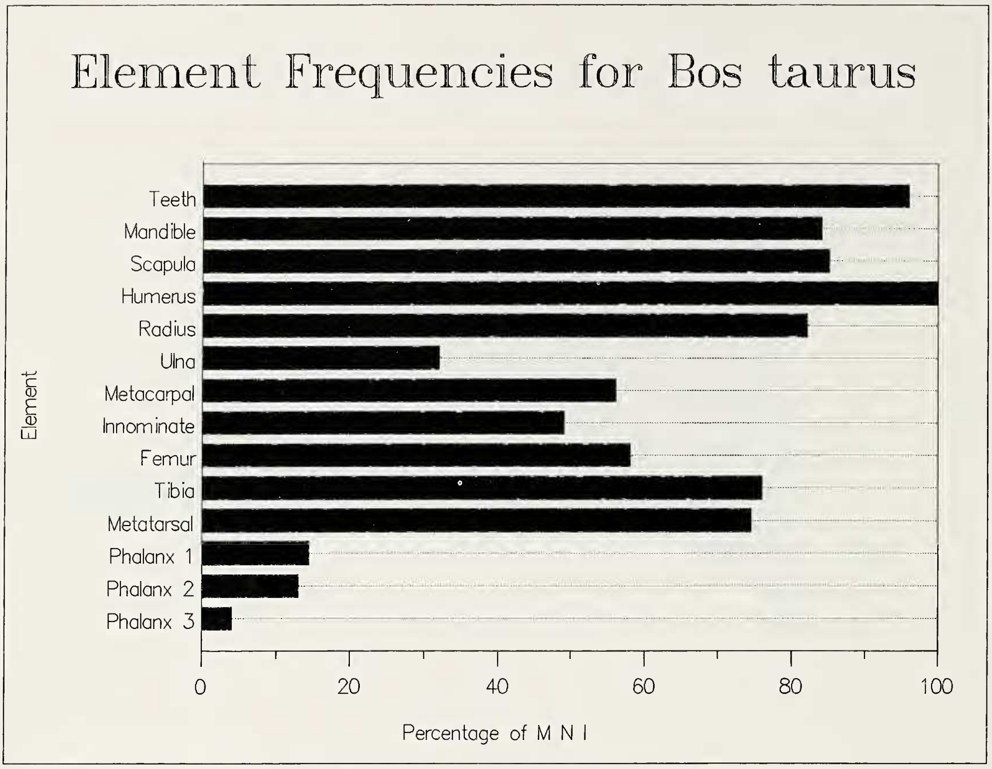

Fig. 8.—Element frequencies for *Bos taurus.*

chew on bones. Both foxes and cats are too small to have inflicted serious damage on cattle bones. Given the prevalence of severe gnawing on ungulate long bones, this taphonomic factor may explain why small toe bones, carpals, and tarsals of these species were underrepresented in the faunal assemblage (Fig. 4–8). It probably also contributed to the paucity of remains of smaller taxa such as birds, insectivores, rodents, and hares. Four small bone splinters that have a sheen extending over their broken edges and medullary surfaces appear to have been acid-etched. The best explanation is that these pieces passed through the digestive system of a carnivore (Payne and Munson, 1985; Horwitz, 1990), most likely the domestic dog.

Sedimentary abrasion was the second most destructive taphonomic process. Abrasion striations caused by the great amount of sand in the soil were often observed on bone surfaces. The cause of this abrasion is some form of pedoturbation which, given the environmental and geologic settings, most likely involved trampling by ungulates and people (Olsen and Shipman, 1988). Much of the postdepositional breakage of bones may also have been caused by trampling. Many of the cow scapulae are heavily abraded and exhibit a recurrent breakage pattern in which a V-shaped notch is broken out of the center of the blade. The mouth of the V is at the vertebral border. This breakage pattern might be expected if a hoofed animal stepped on a scapular blade that was lying flat on the ground. The missing area on these scapulae represents the thinnest, weakest part of the

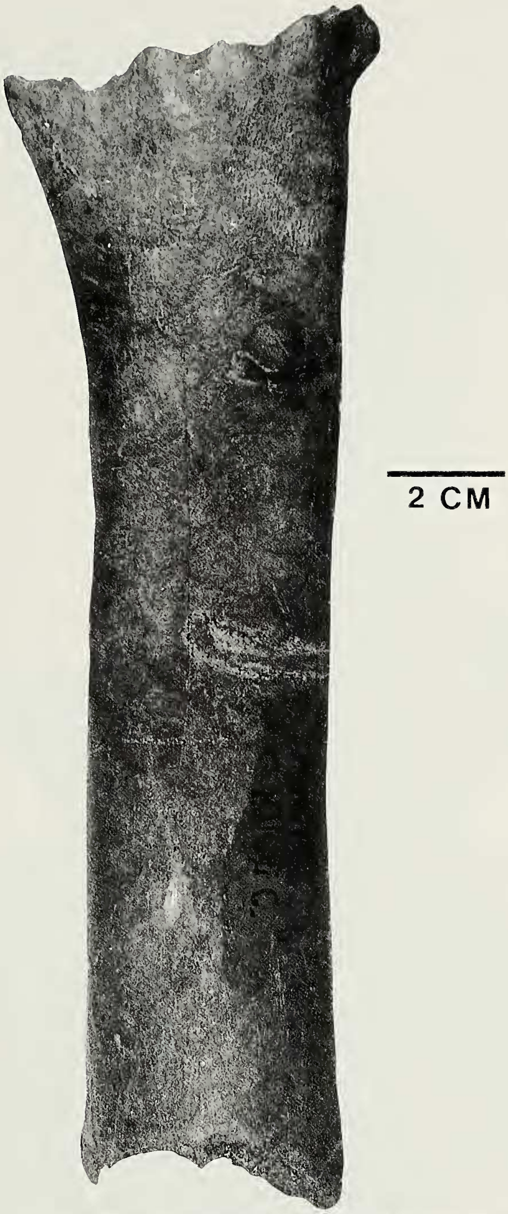

Fig. 9.—Carnivore gnawing on the ends of a cow radius.

blade. The scapular spine is also rarely preserved. Abrasion usually appears as sets of fine parallel striations that sweep over the bone surface rather than gouging deeply into it (Olsen and Shipman, 1988). Abrasion can vary from a polish to coarse striae as great as 1 mm in width. Although it is normally easy to distinguish between sedimentary abrasion and cutmarks, abrasion can obscure or erase evidence of butchery.

Root-etching was also distributed throughout the assemblage, but was never

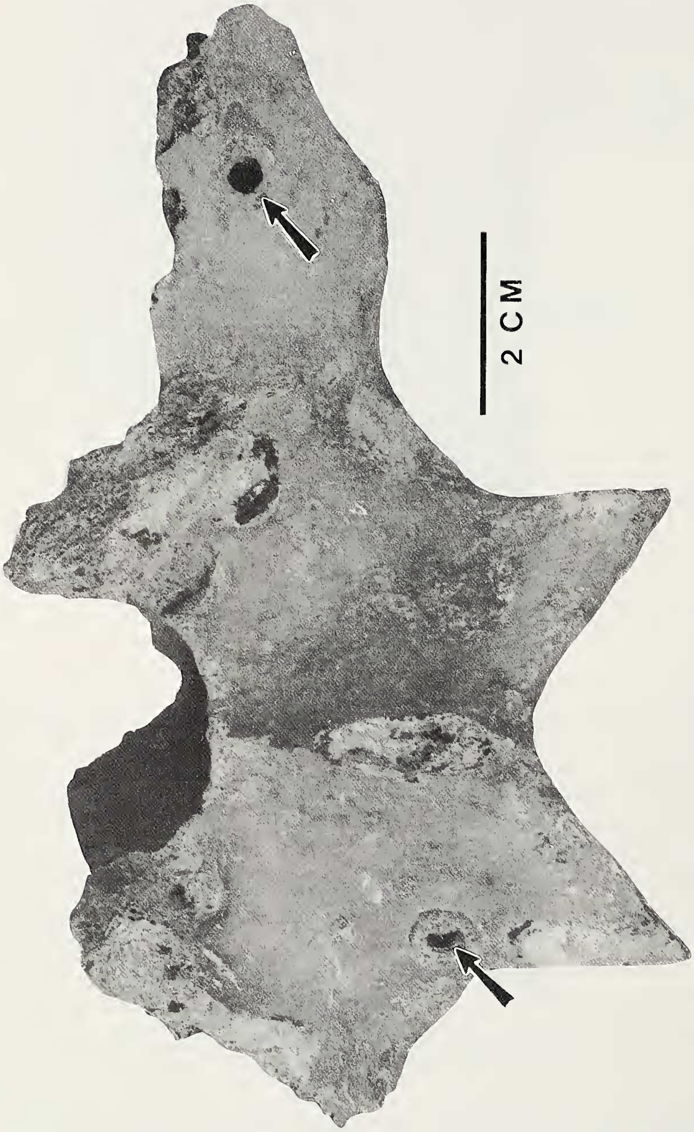

Fig. 10.—Perforations in a lumbar vertebra of cow probably caused by large roots.

Table 3.—*Taphonomic modifications to identifiable bone fragments.*

Taphonomic process	NISP	% of NISP[a]
Carnivore gnawing	347	4.2
Sedimentary abrasion	333	4.0
Root etching	270	3.3
Erosion	168	2.0
Weathering	100	1.2
Rodent gnawing	6	0.1
Burning	5	0.1

[a] $n = 8262$, number of identifiable bone fragments, excluding bones identified only as Class Mammalia.

dense on any given bone fragment. The small dendritic grooves, etched by the acid produced at the tips of rootlets, indicate that there had been a ground cover of vegetation shortly after the bones were deposited. This is also evident from the peat deposit overlying the sandy soil. A few bones are bored with round holes that show no indication of tool marks (Fig. 10). Some of these holes may have been made by the roots of larger plants, possibly tree seedlings. Similar perforations have been observed by the author in human burials in the eastern United States where the roots were still in place. Baker and Brothwell (1980:38) recorded comparable perforations thought to be caused by roots pushing through the cranium of a cow. These perforations are often difficult to distinguish from holes made in the ends of long bones to remove marrow. Surficial destruction from root damage was minimal, although some cutmarks were probably obliterated as a result of this process.

Erosion and weathering were the fourth and fifth most common taphonomic processes witnessed at West Row Fen. Erosion caused deterioration of the outer

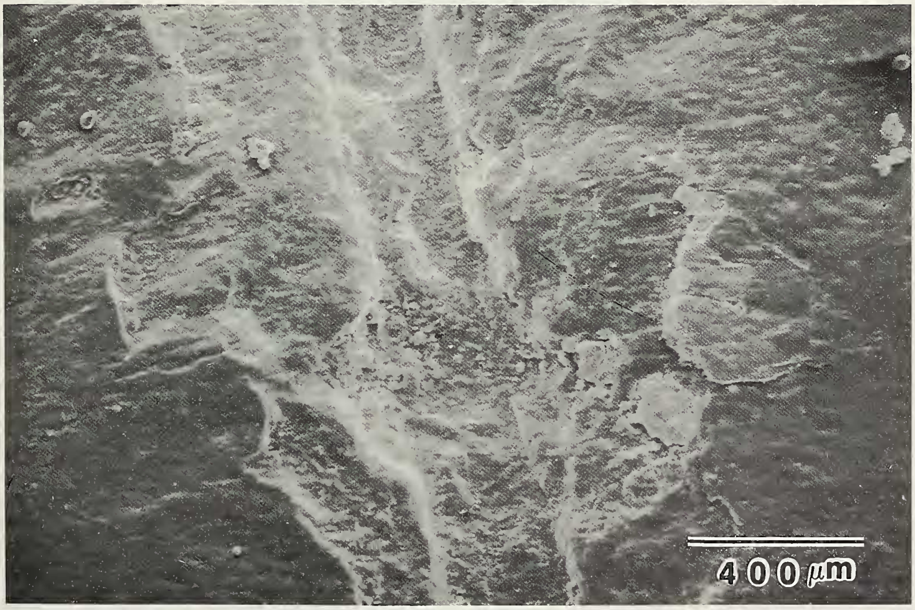

Fig. 11.—Scanning electron micrograph of a cutmark made with a dull metal knife. Note the ragged margins and unstriated, flat-bottomed groove.

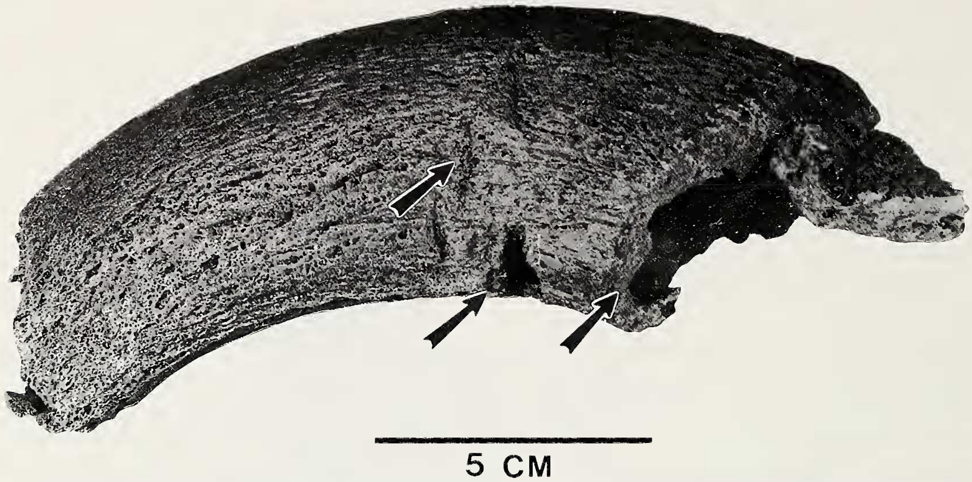

Fig. 12.—Horncore of a domestic short-horned bull with axe chopmarks around the base made during removal of the horn.

cortical bone surfaces and probably erased some evidence of cultural modification. Weathering generally resulted only in shallow surface cracks with an absence of surface exfoliation. Rodent gnawing was surprisingly rare at West Row Fen, an indication that vermin were kept to a minimum during the occupation of the village. Bones were buried relatively rapidly, and disturbance by burrowing animals was probably minimal.

Butchering

Detailed descriptions and illustrations of butchering patterns accompany the discussions of most species. Bronze tools were not abundant at West Row Fen at this technological stage (E. Martin, personal communication), but there is evidence of their use in butchery. Certain criteria can reveal whether a stone or a metal tool was used to cut bone in well-preserved cases (Olsen, 1988). Most of the fine cutmarks were probably made with stone tools such as unretouched blades or flakes. These tools leave very narrow V-shaped grooves with microscopic parallel striations running along the walls of the groove (Olsen and Shipman, 1988). Metal knives, however, leave wider grooves with smoother walls and fewer parallel striations. Metal knife marks are less common than those made with stone tools, but in one example multiple cuts were made with a dull metal knife that left broad, flat-bottomed grooves with very ragged margins (Fig. 11).

Although stone butchering tools were dominant on the basis of cutmark analysis, metal axes may have been used to chop antlers and bones. The chopmark produced by a chipped stone axe is a broad, open V-shaped notch with visible macroscopic striations running down into the groove roughly perpendicular to the long axis of the mark (Olsen and Shipman, 1988). A chopmark made with a metal axe has much smoother walls, with only very faint microscopic striations. Distinguishing between chopmarks made with very thin ground stone axes and those made with metal axes is difficult, however, since both cuts have relatively smooth walls. A

Table 4.—*Perforations in the ends of elements for marrow extraction.*

Bag number	Taxon	Element	End perforated
0238	*Ovis aries*	radius	distal
0912	*Ovis/Capra*	radius	both
0912	*Ovis/Capra*	radius	distal
0912	*Ovis/Capra*	metacarpal	both
0912	*Ovis/Capra*	tibia	distal
0912	*Ovis/Capra*	metatarsal	proximal
0912	*Ovis/Capra*	first phalanx	proximal
0916	*Ovis/Capra*	radius	distal
0916	*Ovis/Capra*	tibia	distal
5311-II	*Ovis/Capra*	radius	proximal

few thin ground stone axes were found at West Row Fen, so it is possible that these were used to chop through bones. The West Row people apparently used either ground stone or metal axes to hack through the bases of horn cores (Fig. 12) and tough joints of cattle, as well as deer antler beams and tines.

The use of unretouched stone blades for cutting meat and metal axes for chopping through horn and bone seems to indicate efficiency. Metal axes produce greater results with fewer blows than chipped stone axes; unretouched blades are sharper, more easily obtained, and easier to manufacture than metal blades.

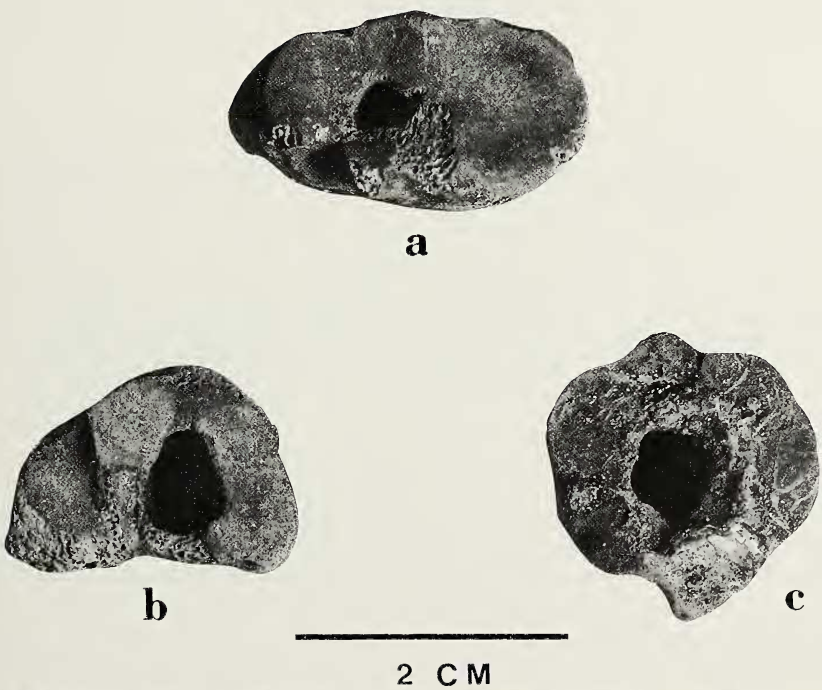

Fig. 13.—Perforations made in the ends of caprine long bones to extract marrow: a, proximal radius; b, proximal metacarpal; c, proximal metatarsal.

Fig. 14.—Posterior surface of a caprine radius with a rectangular opening for marrow extraction.

MARROW EXTRACTION

Given the intensive carnivore gnawing of long bones at West Row Fen, it is difficult to assess the frequency of marrow extraction by humans based on spiral or "green bone" fractures. There are other types of modifications that were performed by humans for this purpose, however. Long bones of sheep or goats, were perforated at one or both ends (Table 4) in order to remove the marrow. In these cases, openings were made with a gouge and then reamed or enlarged by scraping around the interior margins until they measured from 4 to 14 mm in diameter (Fig. 13). Experimentation on the articular ends of fresh bones showed that this can be done easily without leaving noticeable tool marks around the rim or wall of the perforation. In three specimens the epiphysis was removed from the diaphysis so that the soft metaphyseal material could be reamed out. In one case, the intact epiphysis was found near the perforated diaphysis in the deposit. Marrow was also extracted from a sheep or goat radius by incising a rectangular opening in the posterior surface of the diaphysis near the proximal end (Fig. 14).

Two proximal cow phalanges were opened to extract marrow from the cavity by percussion with a chipped stone hammer (Fig. 15). The two phalanges were found together and were probably derived from the same individual.

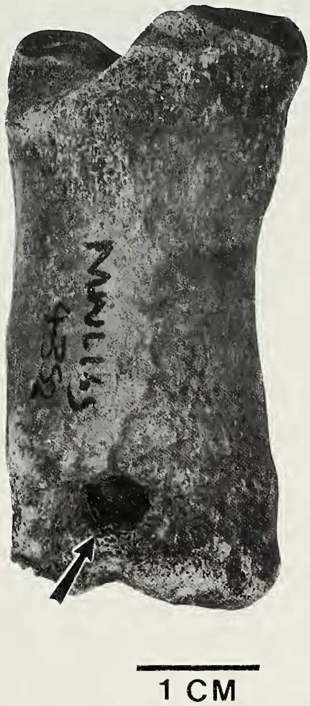

Fig. 15.—Proximal phalanx of a domestic cow opened with a hammerstone to extract marrow (dorsal surface).

Burning

Only five identifiable bones were found to have been burned (Table 3). Most burning does not occur during cooking, because meat is an excellent insulator, but instead takes place after the meal when the bones are discarded in the fire. Such disposal reduces the odor and unsanitary conditions caused by rotting meat and marrow, while providing some fuel for the fire. The prevalence of domestic dogs in the village (as indicated by their remains and the incidence of carnivore gnawing) may have led to the practice of throwing the bones to the dogs, rather than discarding them in the fire. Moreover, the nearby woodlands would have yielded far superior sources of fuel than that provided by bones.

Pathology

Only a few cases of pathologically altered bones or teeth were observed in this faunal assemblage. Most were congenital anomalies, healed injuries typically associated with domestication, or changes probably caused by traction. The scarcity of pathologies suggests that the domestic animal populations were healthy, but also that many individuals did not avoid culling long enough to develop serious diseases or to mend from an injury. There were no fetal and few neonatal remains recovered, but dogs may have destroyed many of these fragile bones.

The Mammalian Fauna

Erinaceus europaeus, *Western Hedgehog.*—Three hind limb elements (a femur and two tibiae) were identified. Hedgehogs, known at least by the early Mesolithic in Britain at the site of Thatcham, Berkshire (Davis, 1987:174), occur both in woodlands and grasslands (Corbet and Ovenden, 1980:120).

Talpa europaea, *Northern Mole.*—The fused sacrum and innominates of a northern mole were recovered from the area containing the Neolithic pits. Because of this species' habit of burrowing, the mole may have entered the site either during or after its human occupation. They presently occur in British grasslands and deciduous woodlands (Corbet and Ovenden, 1980:122).

Lepus, *cf.* L. capensis, *Brown Hare.*—Nineteen bones of hares were identified in this assemblage. Rabbits, *Oryctolagus cuniculus,* apparently did not spread through Britain until the Norman Invasion (A.D. 1066) (Corbet and Southern, 1977). The remains identified at West Row Fen have proportions comparable to *Lepus* rather than to *Oryctolagus. Lepus capensis* occurs in the area today, but it is possible that another species could have occupied Britain in prehistoric times (Grant, 1984). The blue hare, *L. timidus* was recorded in the early postglacial from Hartledale (Tinsley, with Grigson, 1981:218). At West Row Fen, no cranial remains were recovered and the partial mandible did not allow identification to species level. The MNI for hares is only three, but dogs could have destroyed many of the scraps left from meals of this small game.

Order Rodentia, Genus and Species Indeterminate.—Only a few rodents were found in the general faunal assemblage identified here. Most of the rodent elements were recovered from the sieved material and are currently being studied by T. P. O'Connor. The paucity of rodent bones may be due in part to the activities of village dogs.

?Arvicola terrestris, *Northern Water Vole.*—This species is normally associated with freshwater marshes, lakes, or slow-moving streams; however, it may live in grasslands away from water (Corbet and Ovenden, 1980:164). Although water voles could have been consumed by humans, it is likely that they entered the archaeological deposits intrusively at the time the peat was forming. Eleven of the 14 bones, probably all from the same immature individual, came from a single pit.

Felis sylvestris, *European Wild Cat.*—One tooth and three limb bones were recovered. These elements are difficult to distinguish from the domestic cat, *F. domesticus,* but there is no evidence that domestic cats entered Britain before the Iron Age. A cluster of kitten skeletons found at Gussage All Saints, an Iron Age site in Dorset occupied around 500 b.c. (uncalibrated), was used to establish domestication (Harcourt, 1979). The relatively large size of the radius and femur from West Row Fen supports their identification as wild cat rather than a domestic breed. Wild cats may have lurked around middens at night to catch rats and mice, although dogs would certainly have helped deter this behavior. Alternatively, wild cats may have been hunted for their fine fur to make small bags or garments.

Vulpes vulpes, *Red Fox.*—One lower jaw and nine limb bones were found strewn across a small area and could represent one adult animal. None of the bones has unfused epiphyses, and the age of fusion for the identified bones ranged from 19 to 28 weeks (Davis, 1987). Foxes might have been killed because they were pests and a threat to the young livestock, as foxes scavenge sheep and goat carcasses (Stallibrass, 1984) and could kill a newborn lamb or kid.

Two cases of butcher marks on fox bones are almost certainly the result of skinning. The first consists of several short, shallow cuts on the lateral side of the shaft of a fifth metacarpal (bag 0882) just distal to the proximal articular surface. These probably occurred when an annular incision was made around the wrist to remove the hide. The second mark was found on the anterior surface of a distal tibia (bag 0933) and could represent an analogous cut around the ankle (Guilday et al., 1962:71). The removal of hides frequently stops short of including the strongly adhering skin of the feet and toes since this skin is of little value. Annular cuts at the wrist and ankle allow the hide to be removed in one piece, exclusive of the feet.

Canis familiaris, *Domestic Dog.*—The quantity of gnawed bones in this assemblage indicates that dogs were adept at cleaning up the food refuse produced by the village. Hunting was minimal at West Row Fen in comparison to the rearing of domestic stock, although dogs could have been trained to assist in periodic hunts. It is more likely that dogs were used to herd and protect livestock from predators such as foxes and wild cats. The dogs were medium-sized and the cranium and mandibles show characteristics of domestication such as foreshortening of the rostrum (Fig. 16). Domestic dogs are known in Britain since Mesolithic times at Star Carr (7538–7607 b.c., uncalibrated) (Degerbol, 1961).

The dentition and epiphyseal fusion data on dogs show that most of the remains preserved are from adults. The only exceptions are a mandible containing a deciduous second premolar (aged five weeks to six months; Silver, 1969) and a radius that was unfused distally (aged less than 47 weeks; Silver, 1969). One cervical, probably from an old individual, bears traces of possible osteoarthritis in the form of lipping around the cranial end of the centrum on the ventral surface.

Approximately 63% of the *Canis* material represents the skull and first two vertebrae, whereas the remaining 37% is mostly appendicular. Two atlas vertebrae (bags 5382 and 10498) have cutmarks on the ventral surfaces associated with decapitation. Diagonal marks immediately adjacent to the right anterior articular facet of one and transverse marks on the body of the other (Fig. 17) were most likely made while removing the head from the body. Another cervical (bag 4237) also bears transverse cutmarks on its dorsal surface. Deer, sheep, pigs, and cattle were also decapitated as a normal part of the butchering process at West Row Fen; therefore, no sacrificial or ceremonial inferences need to be made in the case of dogs.

The anterior surfaces of two dog radii show fine transverse cuts near the proximal ends, as does the posterior surface of a tibia. Deep cuts like these at the elbow and behind the knee suggest disarticulation of the carcass as a part of food preparation rather than skinning (Guilday et al., 1962:67). The internal surface of one rib was also butchered in a way consistent with food preparation or consumption.

Cunliffe (1991) reported a high frequency of butchered dog bones at the Iron Age site of Highfield. At West Row Fen, the lack of dog burials, the presence of butchering marks, the scattering of their bones throughout the site, the deposition of a partial skeleton and isolated bones in refuse pits (Table 1), and the occurrence of one spirally-fractured and one burnt dog bone suggest that these animals were probably eaten and were not particularly revered as pets.

Capreolus capreolus, *Roe Deer.*—Roe deer were present in Britain intermittently during the Pleistocene interstadials and continuously after the Preboreal (ca. 8300 b.c.), when forests replaced grasslands. They appear in prehistoric sites in or near forests from the Mesolithic on, but their numbers generally decline in the Neolithic as domestic stock becomes increasingly more important (Grigson, 1984).

At West Row Fen, roe deer element frequencies do not vary dramatically, which is compatible with the idea that these small animals were probably carried into the site whole. The sample is too small to construct a mortality pattern, but epiphyseal fusion and dental evidence show that adults were taken more frequently than juveniles. Roe deer would have provided about the same amount of meat

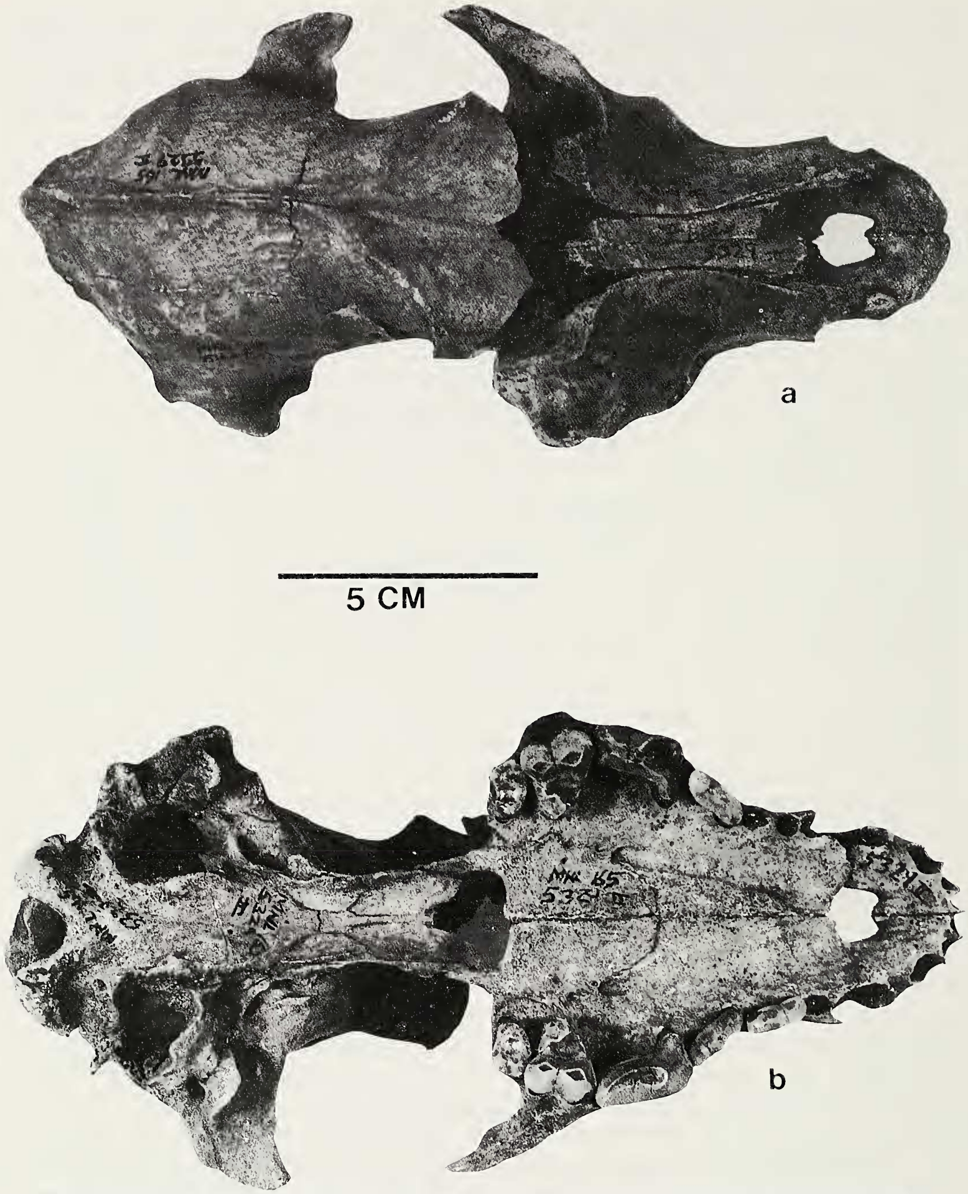

Fig. 16.—Domestic dog cranium from West Row Fen: a, dorsal view; b, basicranial view.

as the small Soay sheep, but, as wild game, would not have yielded milk and wool. Roe deer rank seventh at West Row in the amount of contributed meat (Table 2).

Roe deer antlers, because of their small size, spatulate shape, thin cortical layer, and predominantly spongy interior, were much less useful for manufacturing artifacts than were the antlers of red deer. As far as can be discerned, all of the

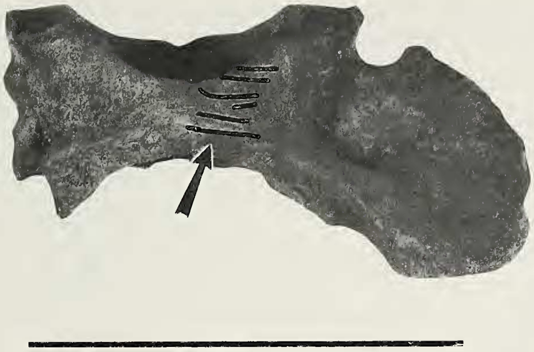

Fig. 17.—Ventral view of a dog atlas, illustrating locations of cutmarks.

worked antlers from West Row Fen are derived from red deer. One of the unmodified roe deer antlers, however, was collected after it was cast by the deer.

Cutmarks on the medial shaft of one roe deer metacarpal imply skinning. The distal epicondyle of a humerus bears several annular cutmarks, like those usually associated with the removal of the forearm flexors and extensors. Two astragali and one calcaneous exhibit transverse cuts that represent disarticulation of the ankle. All of these are common butcher marks made in the preparation of a medium or large mammal for consumption.

Cervus elaphus, *Red Deer.*—Red deer have a paleontological distribution pattern similar to that of roe deer—flourishing in the Pleistocene interstadials and returning with the forests of the Holocene. They, too, have been identified in sites that date back to the Preboreal (Davis, 1987). At West Row Fen, red deer remains were more plentiful than those of roe deer according to their NISP, but less common in their MNIs. Red deer yield about nine times as much meat as roe deer, however, and have antlers that are far more useful for manufacturing artifacts. By weight of usable meat, the red deer is the third most important species consumed at West Row Fen.

The one definite piece of seasonality information comes from an antler still attached to the frontal bone (bag 5349) of a deer that was killed between September and March. Four red deer antlers were chopped through the beam just above the pedicle, suggesting that they were cut from the frontal during butchering. The most remarkable of these was found in Pit 4284 and is 42 cm long. It had been split in half longitudinally by chopping with a metal axe in preparation for artifact manufacture. Three cast antlers demonstrate the apparent need at West Row Fen to gather this valuable raw material for artifact manufacture. Two of the cast antlers were made into mace-heads. Additional antler artifacts include four rod-like flakers, eight modified tines, a wedge, and a hollow handle.

That red deer provided meat and hides as well as antlers for making artifacts is evident from the butchering patterns. The atlas of one red deer bears several long cutmarks on the ventral surface reflecting decapitation. The anteromedial surfaces of two radii exhibit fine cuts near the proximal ends, inflicted when the elbow joint was disarticulated. Finally, a proximal phalanx was cut on the side just above the distal condyle during skinning.

Table 5.—*Survival based on epiphyseal fusion for* Sus scrofa. *Ages of fusion based on Silver, 1969:252–253.*

Age in months	Element	End[a]	Unfused Left	Unfused Right	Fused Left	Fused Right	% Surviving[b]
12	humerus	D	4	2	2	4	50
12	radius	P	1	0	2	2	80
24	tibia	D	0	1	1	5	86
42	femur	P	1	2	0	0	0
42	radius	D	2	1	0	0	0
42	tibia	P	0	5	0	0	0
42	femur	D	2	2	0	0	0
42	humerus	P	2	0	0	0	0

[a] P = proximal, D = distal.
[b] Surviving beyond age of fusion.

All red deer bones retaining epiphyseal areas are fused. Identified teeth include one left and right deciduous premolar and 28 permanent cheek teeth. There is little evidence that juvenile red deer were hunted with any frequency.

Sus scrofa, *Pig.*—Wild boars, like the roe and red deer, invaded Britain once the forests began to dominate and were present from the Preboreal onward. The earliest evidence for small, apparently domestic, pigs is derived from the Neolithic causewayed camp at Windmill Hill (ca. 2960 b.c., uncalibrated; Davis, 1987:177).

Osteological features alone do not reveal whether wild boars were hunted occasionally by West Row people. Two large adult pig bones—a temporal and an ulna—were recovered, but since fully adult domestic pig bones are rare in this collection, the maximum size of a typical domestic male cannot be estimated. Milisauskas (1978:67) estimates a significant difference between the amount of usable meat produced by an average wild boar (53.75 kg) compared to an early domestic pig (15 kg).

Most of the fused epiphyses were those that fuse at birth or within the first two years of life (Table 5). Those that fuse between 2 and 3.5 years were always unfused. The quantity of immature bones argues that most, if not all, of the pigs at West Row Fen were domesticated and that culling of young individuals occurred.

Based on the teeth (Table 6), a slightly different picture of the age structure of pigs at West Row Fen emerges. Bull and Payne (1982) demonstrated that there are only minor differences between wild boars and modern domestic pigs in the timing of tooth eruption and epiphyseal fusion. Therefore, the age categories for wild boars have been applied to the dentition of Early Bronze Age domestic pigs. Wild boars mature only slightly quicker than modern domestic pigs, which have undergone far more artificial selection than the Bronze Age pigs. The dental evidence from West Row Fen shows that at least some individuals survived long enough to reach full size. Based on the right mandibles, the most common jaws in the assemblage, 45% of the pigs were being killed in the first 16 months of life. Another 36% died between 19 and 35 months, and 18% survived to about four years or beyond. This pattern suggests that while the mortality rate was heavy in the first year, at least some pigs were reserved for breeding and were kept to grow until they were needed for their meat. It was uncommon, however, for a pig to survive beyond three years.

The average dressed weight of a mature European wild boar is about 36.4 kg, but it is just 13.6 kg for a wild piglet (Henry, 1969; Biddick, 1984:165). Assuming comparable ratios for early domestic pigs in Britain, the mortality patterns bear

Table 6.—*Age distribution of* Sus scrofa *based on mandibles with two or more teeth. Aging of dentition done by using Silver (1969) for dates of eruption and Bull and Payne (1982) for wear stages.*

Age category	Left	Right
1 week to 16 months	1	
7 weeks to 16 months	2	
4 months to 16 months	1	2
7 months to 16 months	2	1
8 months to 16 months	1	
19 months to 23 months	1	3
19 months to 35 months	1	
31 months to 35 months	3	1
Over 35 months		2
Total	12	9

on the relative importance of pork in the diet of the West Row people. Although some individuals were kept to adulthood, most were slaughtered before full growth had been achieved. This would considerably lower their relative dietary contribution compared to cattle and red deer, which were primarily slaughtered as adults. However, pork has a higher caloric value than beef, venison, or mutton. Per kilogram, mutton provides 1500 calories; beef, 2000 calories; and pork, 3700 calories (Flannery, 1969). If calories are considered over pure units of meat weight, pigs would again increase in relative value, although their caloric value would depend in part on whether juveniles have the same proportion of fat as adults.

Butchering marks are not very common on pig bones (Fig. 18; Table 7) except on the distal epicondyles of humeri. Marks on a lacrimal and on the lingual surface of a mandible (not figured) illustrate that skin and meat were removed from the head. One occipital bears traces of decapitation. Cutmarks on a scapula, humeri, an innominate, and a femur were probably made while removing meat and disarticulating the joints. Ribs were cut away from the vertebrae in the process of disarticulating the carcass. Ribs were also scraped on the internal surfaces probably during human consumption of the intercostal muscles. Removal of the hock is indicated by cuts on the astragalus, calcaneus, and navicular bones. One pubis (not figured) bears a cut probably made while skinning or eviscerating the animal.

Live pigs do not produce useful products such as wool and milk, although their manure may be used for fuel or fertilizer. One possible benefit of raising pigs is that they root up the soil thus serving the same function as a plow (Reynolds, 1976).

Although they may have been supplied with grain and legumes occasionally, pigs could have survived primarily on garbage and pannage provided by nearby forests. Grass and bracken would have been available locally in the spring and summer. Stubble left in pastures grazed by sheep and cattle was another possible food source for swine. If pigs were kept primarily for their meat and lard, their numbers would probably have been maintained below the level that would require much provisioning with grain that people could have consumed. Though pigs are inexpensive to feed, if their numbers get too large, they begin to become a nuisance. Too many pigs are difficult to manage because they tend to get into gardens and destroy food intended for people (Rappaport, 1968). Because a female produces eight to ten piglets at a time (Towne and Wentworth, 1950:253), some culling would be necessary to prevent overpopulation.

Ovis aries/Capra hirca, *Domestic Sheep or Goat.*—Sheep and goats were brought

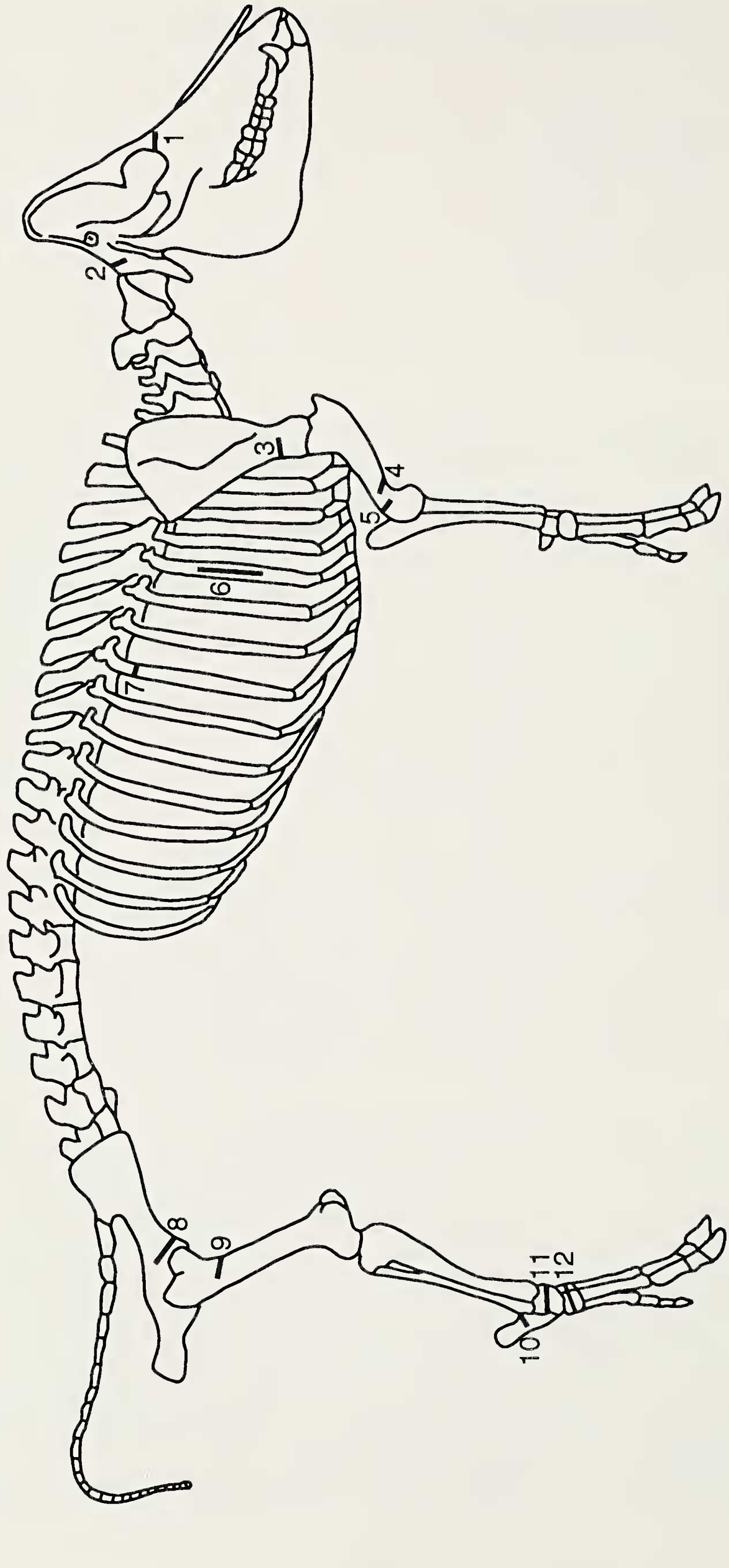

Fig. 18.—Distribution of butcher marks on pig bones.

Table 7.—*Key to butchering patterns for* Sus scrofa.

Location and type	Number of bones cut
1. Skinning	1
2. Decapitation	1
3. Disarticulation of shoulder	1
4. Muscle removal	2
5. Disarticulation of elbow joint	2
6. Muscle removal	2
7. Segmentation of thorax	2
8. Disarticulation of hip	1
9. Muscle removal	1
10. Severing Achilles tendon	1
11. Disarticulation of ankle	2
12. Disarticulation of ankle	1

into Britain across the English Channel during the Neolithic (Ryder, 1983:64–65) and increased in numbers compared to other livestock in the Bronze Age as the forests diminished (Trow-Smith, 1957). By NISP, caprines were second in frequency to cattle at West Row Fen, but the MNI for caprines was higher than for cattle (Table 2). Since it takes the meat of 28 sheep or goats to match that of a cow, however, it is clear that far more pounds of beef were produced in the village than mutton or goat meat.

Of the six bones identified as those of domestic goats, three were horn cores. The breed of these goats is not discernable; they appear to have been small and gracile like the sheep, but are far less common. Sheep thrive much better in cool, wet lowland farming communities, whereas goats prefer hotter, more arid climates (Redding, 1984:237) and rugged terrain. According to Grant (1984), sheep were also much more plentiful than goats during the Iron Age in Britain. Mixed herds of sheep and goats are common among livestock herders, partly because goats are thought to improve herd management and to provide leadership for the sheep, although this has never been scientifically documented (Redding, 1984:29).

The sheep from West Row Fen were small, slender-limbed, two-horned individuals that are within the size range of the Soay breed. According to Reynolds (1987), Soay sheep probably developed as a breed during the Bronze Age and were common until the Iron Age, when four-horned breeds like the Hebridian and Manx Loghtan breeds arose.

Because of their fragmentary nature, most of the bones in this size range could only be identified as caprines (*Ovis aries/Capra hirca*). Although the better preserved material hints that sheep considerably outnumbered goats, we cannot make that assumption for the bulk of the less-identifiable material.

Survival patterns reflected by epiphyseal fusion for *Ovis/Capra* indicate that there was a serious drop in the proportion of individuals living beyond the first year (Table 8). At ten months, over 90% were still alive, but by 13 months only half to a third remained. By 3 to 3.5 years, only a third to a quarter survived. This pattern is similar to the one seen in the pig dentition records and suggests that culling of young individuals took place. In this case, the reason for killing juveniles is probably more than just a desire for the meat, although lamb is preferable to mutton. Cultures relying on sheep and goat dairy products need to kill enough of the young to have a surplus of milk for human consumption (Davis,

Table 8.—*Survival based on epiphyseal fusion for* Ovis aries/Capra hirca. *Ages of fusion based on Silver, 1969:252–253, except for phalanges. At West Row the proximal epiphyses fused* ***after*** *the distal epiphyses in cattle and caprines, counter to Silver.*

Age in months	Element	End[a]	Unfused Left	Unfused Right	Fused Left	Fused Right	% Surviving[b]
10	humerus	D	1	0	15	19	97
10	radius	P	2	1	17	19	92
13–16?	phalanx 1	P	8	3	3	10	54
13–16?	phalanx 2	P	2	4	7	4	65
18–24	tibia	D	7	5	10	11	64
18–24	metacarpal	D	4	5	1	1	18
20–28	metatarsal	D	4	2	2	3	45
30–36	femur	P	6	6	0	3	20
36	radius	D	12	12	5	5	29
36–42	tibia	P	4	5	1	2	25
36–42	femur	D	4	5	3	2	36
36–42	humerus	P	3	4	1	3	36

[a] P = proximal, D = distal.
[b] Surviving beyond age of fusion.

1987:180; Legge, 1992). Males are usually killed in their first year, leaving only enough to breed with the females. Many of the females are allowed to mature beyond the age of two or three years in order to reproduce and yield milk.

Determined age categories based on caprine mandibles (Table 9) are quite broad and do not often coincide because tooth rows and comparable teeth are poorly preserved from one mandible to the next. Most mandibles preserve only two or occasionally three teeth, but molar alveoli provided additional evidence for aging jaws. Despite these constraints, the data indicate that at least two individuals were killed between the ages of two and three months. Nineteen died before they were two years of age; eight survived past the age of three years, seven of those past 5.5 years, and one beyond eight years. This evidence indicates that many indi-

Table 9.—*Age distribution of* Ovis aries/Capra hirca *based on mandibles with two or more teeth. Age based on Silver (1969) and Legge (1992).*

Age in months	Left	Right
1–24		2
2–3		2
3	1	
>3	1	
3–10	1	
3–24	2	7
9–12	3	
>18		1
18–24		1
<24	4	5
>21	2	4
21–24		2
21–34	1	
10–65		1
34–65	1	1
65–100	5	6
>100	1	
Total	22	32

Fig. 19.—Pathological exostosis on a proximal phalanx of a caprine. Arrows point to abnormal flanges of bone on both sides.

viduals were being maintained well beyond the age when mature weight is achieved, which suggests that their primary function was dairy production rather than meat provisioning. The scant dental data do not reveal whether very young lambs and kids were regularly culled, as would be expected if people were utilizing dairy products.

Unfortunately, there is no evidence for the use of sheep wool at West Row Fen, since no textiles or antler combs suitable for plucking fleece have been found at the site. Sheep shears are not known until Roman times (Reynolds, 1987). However, Bronze Age textiles made from Soay-type wool have been found in England (Ryder, 1983:47). A sample from Rylston, in Yorkshire, consists of a piece of yarn made of fine fibers associated with pieces of a generalized medium and a hairy medium wool (Ryder, 1969).

The only pathology among the caprine bones is a proximal phalanx that has indentations on both sides of the distal epicondyle with lipping above (Fig. 19). The unusual symmetry of these injuries suggests that they may have been induced by a human-made trap or a hobble.

Butcher marks are fairly common on the bones of caprines at West Row Fen (Fig. 20; Table 10). In contrast to the West Row cattle, the horn cores and frontals of sheep and goats do not exhibit chopmarks or cutmarks indicative of the use of their horns as a raw material. Only one chopmark was observed on a caprine bone, in contrast to many on bones of cattle. Skinning marks were found on the maxilla, anterior surfaces of the metapodials, and proximal phalanges of caprines. One hyoid bore traces of cutmarks made when the tongue was removed. The heads of sheep were removed by cutting between the occipital and the atlas, leaving small cutmarks on an occipital and both dorsal and ventral surfaces of an atlas. Disarticulation cuts were found on caprine cervical vertebrae; at the shoulder on

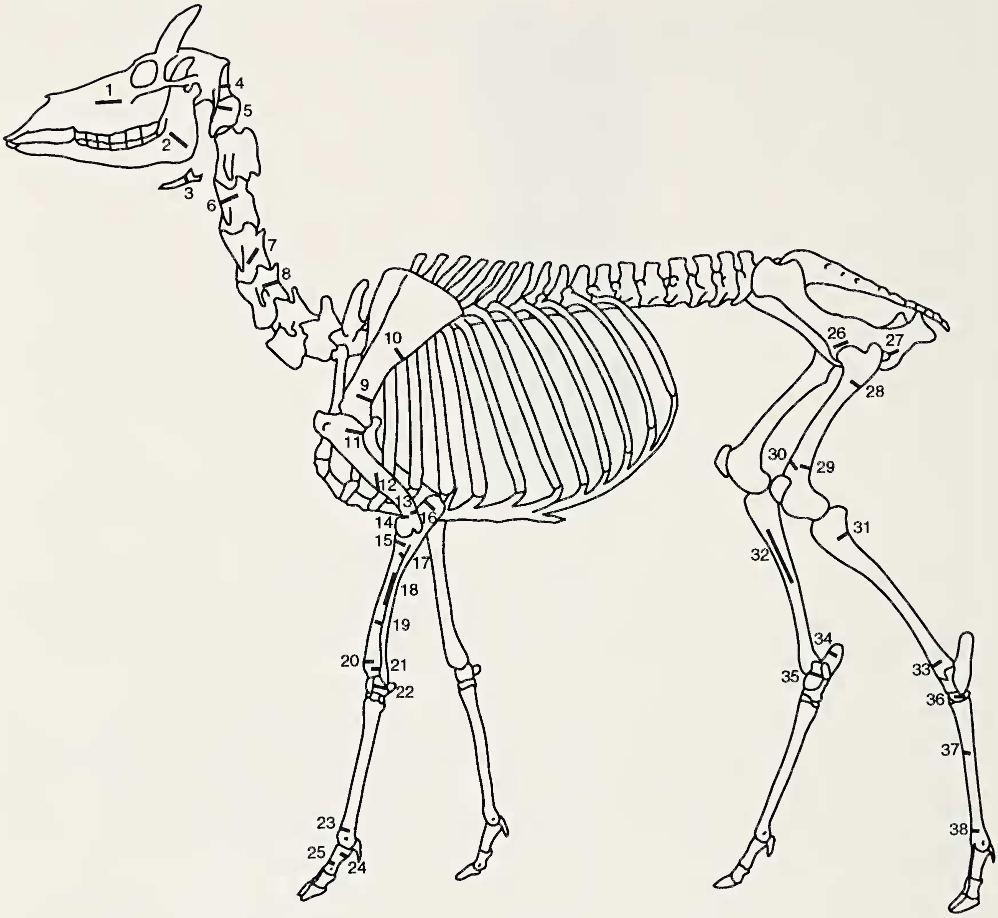

Fig. 20.—Distribution of butcher marks on caprine bones.

the scapular neck and humeral head; the elbow joint on the humerus, radius, and ulna; the distal radius and the scaphoid of the wrist; above the acetabulum of the innominate; and at the ankle on the astragalus, navicular, and calcaneus. Some fileting and other types of meat removal are indicated by midshaft cuts or scraping on the scapula, humerus, radius, femur, and tibia.

To determine how the vertebrae and ribs were butchered, it is necessary to examine the bones that could only be identified as small ruminants, since it is difficult to distinguish among fragments from sheep, goats, and roe deer. These show minor cutmarks on the neural spines of the thoracic vertebrae, a chopmark completely through a thoracic centrum and neural arch (probably with a metal axe), disarticulation of the ribs and vertebrae at the rib's head and tubercle, and scraping of the internal surface of the rib. All of these cutmarks are commonly found on carcasses butchered for food consumption.

Bos primigenius, *Wild Aurochs.*—Most of the *Bos* remains represent domestic cattle. Although a few of the elements are large, only one is attributable to the wild aurochs—a distal humerus with a trochlear breadth of 9.9 cm and proportions comparable to that of a bison.

Table 10.—*Key to butchering patterns for* Ovis/Capra.

Location and type	Number of bones		
	Cut	Chopped	Scraped
1. Skinning	1		
2. Muscle removal	1		
3. Tongue removal	1		
4. Decapitation	1		
5. Decapitation	1		
6. Segmentation of neck	1		
7. Segmentation of neck	1		
8. Segmentation of neck	1		
9. Disarticulating shoulder	2		
10. Muscle removal	1		
11. Disarticulating shoulder	1		
12. Muscle removal	1		
13. Disarticulating elbow	1		
14. Disarticulating elbow	13		
15. Disarticulating elbow	10		
16. Disarticulating elbow	16		
17. Disarticulating elbow	2		
18. Fileting upper forelimb			1
19. Fileting upper forelimb	1		
20. Disarticulating wrist	1	1	
21. Disarticulating wrist	3		
22. Disarticulating wrist	1		
23. Skinning, tendon removal, or disarticulating of joint	1		
24. Same as 23	1		
25. Same as 23	1		
26. Disarticulating hip	1		
27. Eviscerating or skinning	1		
28. Muscle removal	3		
29. Muscle removal	2		
30. Muscle removal	1		
31. Muscle removal	1		
32. Fileting lower leg			1
33. Disarticulating ankle	1		
34. Severing Achilles tendon	1		
35. Disarticulating ankle	3		
36. Disarticulating ankle	2		
37. Skinning	2		
38. Skinning, tendon removal, or disarticulation of metatarsal-phalangeal joint	1		1

The wild aurochs appears to have become extinct in Britain during the Bronze Age (Tinsley, with Grigson, 1981), but its remains have been identified in mixed Beaker and Early Bronze Age deposits at Snail Down; Early Bronze Age levels at Lowes Farm near Littleport, Cambridgeshire; and at nearby County Farm, Mildenhall Fen (Tinsley, with Grigson, 1981:219). A whole skeleton was recovered from Early Bronze Age levels at Charterhouse Warren Farm, Blagdon, in Somerset (1295 b.c., uncalibrated or 1629 B.C., calibrated—Everton, 1975; Clutton-Brock and Burleigh, 1983).

Bos taurus, *Domestic Cattle.*—Cattle are well-suited to the lowlands of the fens, where water is in good supply. They can be used for draft, and yield dairy products, meat, large hides, bones, and horn. However, cattle require considerable pasture

Table 11.—*Survival based on epiphyseal fusion for* Bos taurus. *Ages of fusion based on Silver (1969), except for phalanges. At West Row the proximal epiphyses fused* ***after*** *the distal epiphyses in cattle and caprines, counter to Silver.*

Age in months	Element	End[a]	Unfused Left	Unfused Right	Fused Left	Fused Right	% Surviving[b]
12–18	humerus	D	0	1	20	14	97
12–18	radius	P	3	1	24	20	92
18?	phalanx 1	P	4	2	21	21	87
18?	phalanx 2	P	5	1	27	9	86
24–30	tibia	D	1	2	18	20	93
24–30	metacarpal	D	3	4	6	5	61
27–36	metatarsal	D	1	0	8	7	94
42	femur	P	2	0	1	2	60
42–48	radius	D	1	6	4	3	50
42–48	tibia	P	0	1	4	5	90
42–48	humerus	P	1	1	2	1	60

[a] P = proximal, D = distal.
[b] Surviving beyond age of fusion.

and keeping them reduces the mobility of their owners, which means less opportunity to move to fresh pastures as needed.

The Bronze Age witnessed the development or arrival of a small, short-horned variety of cattle in Britain, which was apparently represented at West Row Fen. The two most-complete horn cores have basal circumferences (180 and 195 mm) well within the range of either Neolithic domestic males or wild females, but the reconstructed length of the outer curvature (roughly 200 to 250 mm) is only about half that for Neolithic domestic males and wild females (Grigson, 1982), suggesting that they were derived from domestic short-horned males.

At West Row Fen, most of the limb bones of domestic cattle are very slender, but few could be measured due to their comminuted state and the extent of carnivore gnawing on condyles. With the exception of the enormous aurochs humerus, the few large specimens may represent the limited number of intact bullocks allowed to reach adulthood. The data from the epiphyseal fusion of cattle long bones (Table 11) indicate that most individuals survived past the age when full growth was obtained. The 90% representation of fused distal tibiae may be an accident of preservation, but it still appears that over 50% of the cattle survived beyond 3.5 years of age. Immature bones are less likely to be preserved, given the activity of dogs and sedimentary abrasion from trampling. However, proportionally far more immature caprine and pig bones are preserved in the assemblage, and they are smaller and more fragile than those of immature cattle.

Cattle mandibles are only slightly better preserved than those of caprines. For the most part, they contain only two to three teeth, and no complete tooth rows are preserved. The largest age group represented by mandibles (Table 12) is in the six- to eight-year bracket and there are more minimum numbers of individuals in the full adult categories than for young juveniles. The age distribution does not imply culling of individuals in the first year of life, suggesting that cattle were kept primarily for meat and draft rather than for their dairy products (Legge, 1992). The high number of survivors beyond six years also argues in favor of their use for pulling plows and carts.

Several pathologies and anomalies were noted on cattle teeth and bones. The mandible of an individual over 28 months in age (bag 0901) shows the absence of the second permanent premolar, with no sign of infection or injury. The absence

Table 12.—*Age distribution of* Bos taurus *based on mandibles with two or more teeth. Age based on Legge, 1992.*

Age in months	Left	Right	MNI	% of total MNI
<1			0	0
1–3		1	1	5
3–6		1	1	5
6–15	2	1	2	11
15–26	2		2	11
26–36	2	3	3	17
36–72		4	4	22
72–96	5	1	5	28
Total	11	11	18	

of teeth is an anomaly found in many domestic species, including cattle (Baker and Brothwell, 1980:137). Another mandible of an individual older than 24 months (bag 5285-II) exhibits malocclusion and unusual wear patterns. An isolated third lower molar (bag 0297) is worn in an uncharacteristically jagged pattern, apparently from malocclusion. A smaller than usual postyzygopophysis, apparently a congenital anomaly, occurs on one thoracic vertebra (bag 0418). Exostosis associated with either an injury or osteoarthritis caused lipping of the semilunar notch on one adult ulna (bag 5279-II). Baker and Brothwell (1980:115) reported a similar pathology from the site of Crandon Bridge.

Importantly, one innominate (bag 5285-II) has a swelling on the ischium involving the acetabular rim and the area just lateral to it (Fig. 21). Baker and Brothwell (1980) reported osteoarthritis on a bovine acetabulum from the Mote of Mark, and Baker has observed many examples of eburnation of the acetabulum of cattle from Roman to Medieval deposits at Winchester (Brothwell, 1981). These pathologies have been interpreted as representing excessive strain on the hip joints due to an activity that leads to overrotation of the femoral head, such as pulling a plow or a heavy cart.

Two adult proximal phalanges of cattle (bags 5101-II and 5118-II) show a heavy development of the tuberosities on the volar surface (Fig. 22), which may indicate that these animals were used for draft. The palmar (plantar in the hind foot) anular ligament spans over the tendons of the digital flexors (Getty, 1975:858–59), binding them against the bone, and attaches to the tuberosities on the volar surface of the proximal phalanx. Heavily developed tuberosities could indicate greater than usual stress on these flexor tendons, which insert on the mesial and distal phalanges. Exostosis development in third phalanges related to stress at the point of insertion for the flexor tendons has been associated with plowing in water buffalo and cattle (Higham et al., 1981).

The pathologies of cattle bones and teeth from West Row Fen are those often associated with domestication. Malocclusion and the anomalous absence of teeth are frequently related to genetic changes brought about by breeding, like the foreshortening of the rostrum. Exostosis caused by injury, strain, or old age is more common in domestic animals because they are provisioned and protected despite their impaired movement. The exostosis on the ulna could have been caused by the additional stress placed on the elbow joint while plowing or pulling heavy loads. Pathologies of the bones of the hips and feet in European prehistoric domestic cattle are more common than those seen in sheep and pig remains, and

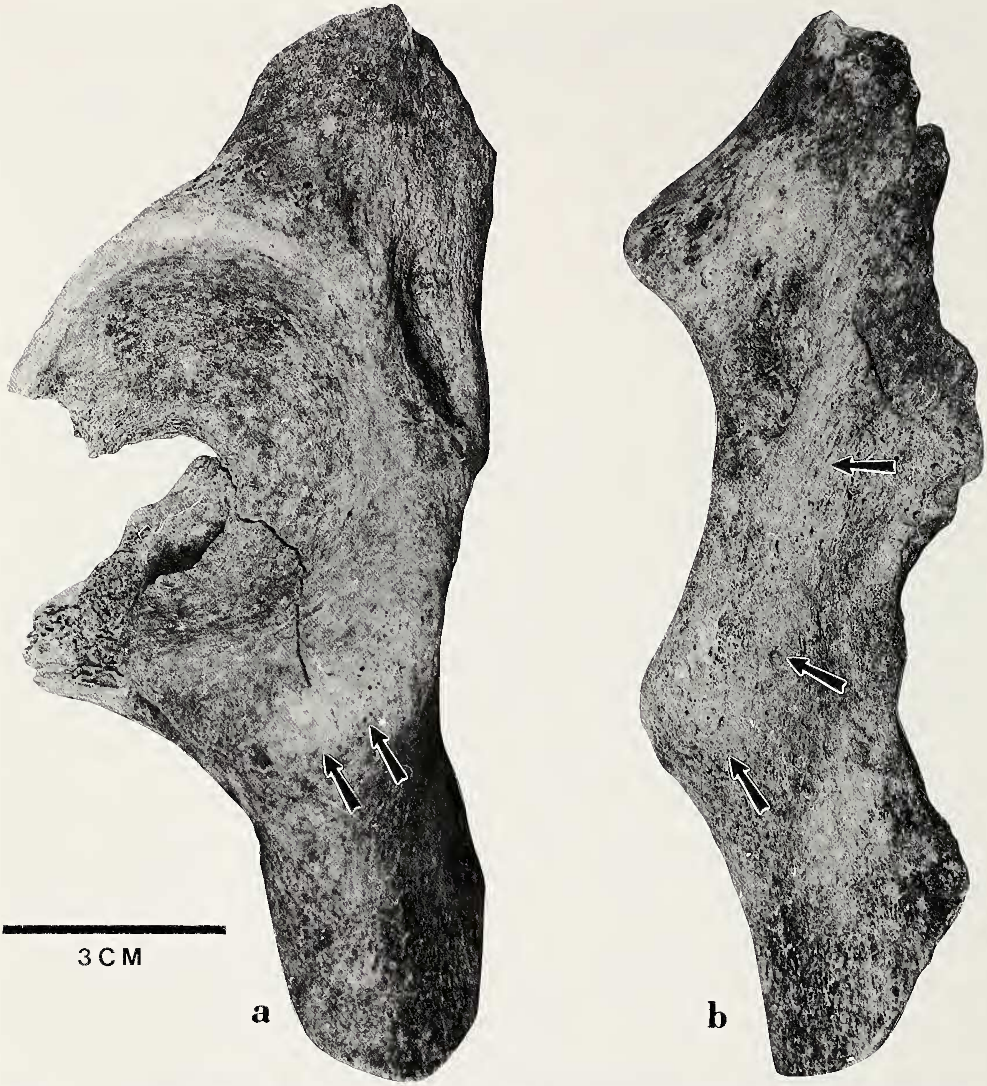

Fig. 21.—Innominate of *Bos taurus* exhibiting a swelling on the ischium involving the acetabular rim and area lateral to it: a, anterior view; b, lateral view.

have been attributed to the impact of stress and strain in cattle due to their use for draft (Baker and Brothwell 1980:117).

The butchering patterns for cattle (Fig. 23, Table 13) are similar to those for sheep and goats with two exceptions. Horn cores and the frontal bones around the cores were often chopped with an axe when removing the horn (Fig. 12). These numerous, heavy marks demonstrate that cow horn was a valued resource for the manufacture of artifacts or glue.

The second difference involves the frequency of heavy chopping compared to fine cutmarks. Chopmarks are rare on the bones of small ungulates, but are much more common on the elements of cattle, which reflects the thicker ligaments and tendons as well as the heavier bones found in cattle.

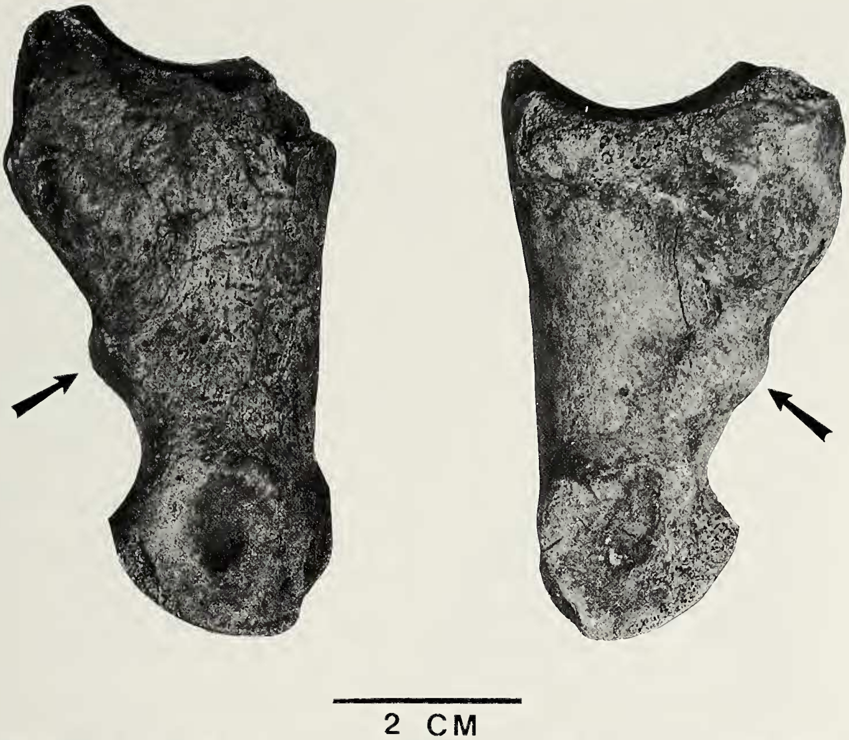

Fig. 22.—Proximal phalanges of oxen showing hypertrophy of the tuberosities for the palmar (or plantar) anular ligament, perhaps resulting from strain inflicted on the digital flexors during plowing or while pulling a heavy cart.

Possible skinning marks occur on the nasal, maxilla, and mandible, as well as on a metacarpal, and first and second phalanges. One hyoid bone bears two cutmarks made during removal of the tongue. Both atlas and axis vertebrae exhibit signs of butchery associated with decapitation. Disarticulation cuts were made between cervical vertebrae in the neck, on the mandible and malar to remove the lower jaw, and at the shoulder, elbow, wrist, hip, and ankle. Meat was removed from the bone of the mandible, scapula, humerus, radius, innominate, femur, and tibia. The most thorough fileting was performed on scapulae, which were often scraped on both surfaces and along the spine. The attention given to this element suggests that the shoulder roast was one of the most preferred cuts of meat. Ribs of large ungulates (probably cattle) were disarticulated from the vertebrae, leaving cutmarks or chopmarks on the rib heads and tubercles.

Cattle at West Row Fen were used for meat and draft, based on evidence from their butchery, mortality pattern, and pathologies. In terms of the quantity of identified specimens and meat poundage, cattle outrank all other species of animals consumed by the people at West Row Fen. The mortality pattern does not suggest that cattle were kept primarily for their dairy products, although it is unlikely that this resource was completely overlooked. Cow horn was an important by-product, judging from the number of chopped horn cores and frontals.

Equus caballus, *Horse.*—Wild horses inhabited Britain throughout the Pleistocene and into the Holocene, but never crossed over to Ireland. Small numbers

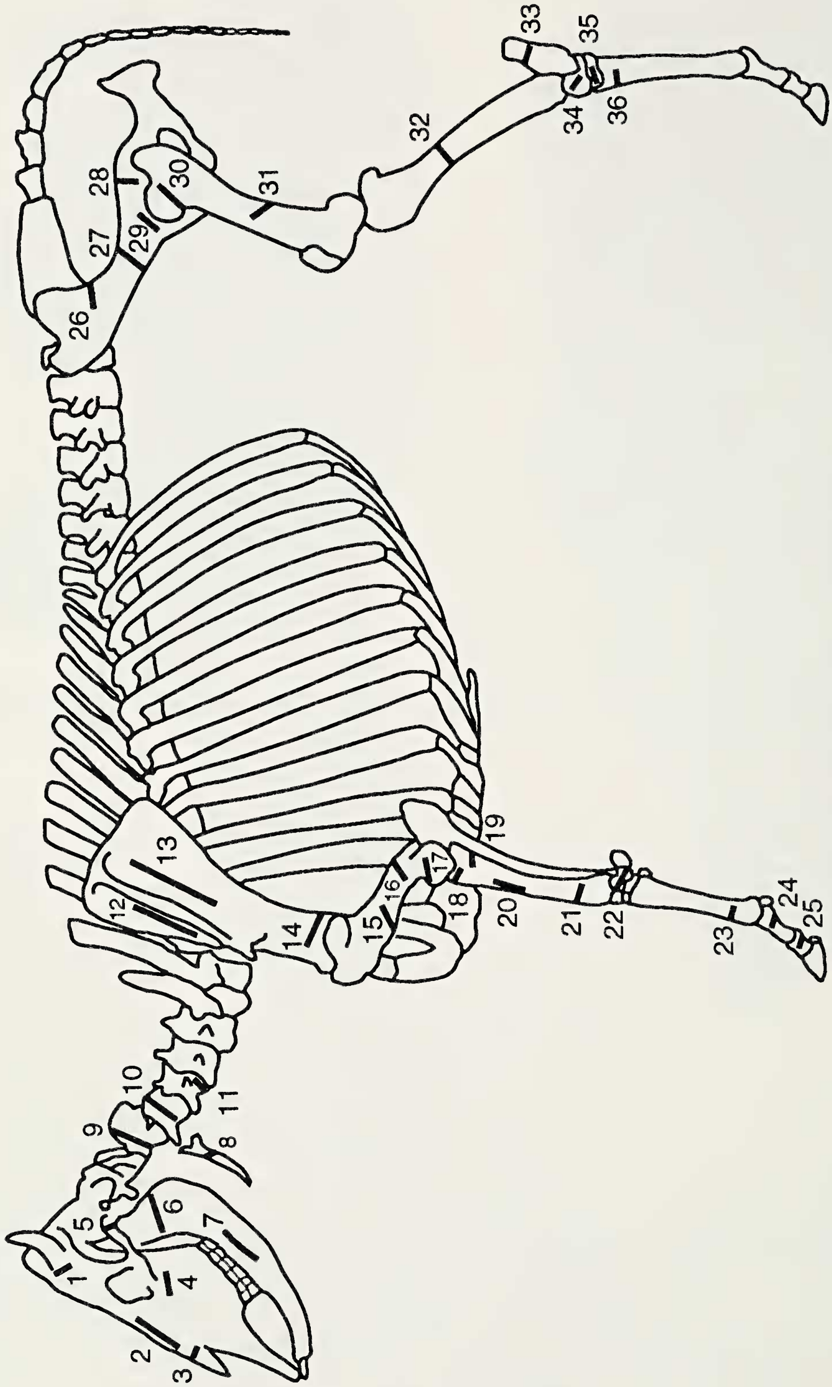

Fig. 23.—Distribution of butcher marks on cattle bones.

Table 13.—*Key to butchering patterns for* Bos taurus.

Location and type	Number of bones		
	Cut	Chopped	Scraped
1. Horn removal		7	
2. Skinning	2		
3. Skinning	3	1	
4. Skinning	2		
5. Disarticulating mandible	3	1	
6. Muscle removal	8		
7. Skinning	4		1
8. Tongue removal	1		
9. Decapitation	2		
10. Decapitation		2	
11. Segmenting neck	2	3	
12. Fileting shoulder			3
13. Fileting shoulder			1
14. Disarticulating shoulder	4	4	2
15. Muscle removal	1		
16. Muscle removal	1		
17. Disarticulating elbow	8		
18. Disarticulating elbow	8		
19. Disarticulating elbow	1		
20. Fileting upper forelimb	1		
21. Disarticulating wrist	1		
22. Disarticulating wrist	2		
23. Skinning	1		
24. Skinning, tendon removal, or disarticulating joint	4		
25. Same as 24	1		
26. Muscle removal	2		
27. Segmenting pelvis	1		
28. Disarticulating hip	2		
29. Disarticulating hip	3		
30. Disarticulating hip	2		
31. Muscle removal	1		
32. Muscle removal	1	1	
33. Severing Achilles tendon	2		
34. Disarticulating ankle	6		
35. Disarticulating ankle	4		
36. Disarticulating ankle	2		
Not shown: Marks on subspinous fossa of scapula from fileting shoulder	17		

of horse remains have been found in Mesolithic, Neolithic, and Early Bronze Age sites in Britain. It is unclear how early domestic horses arrived in Britain, but evidence at Newgrange, in Ireland, demonstrates that they were introduced there by the time of the Beaker Culture (Wijngaarden-Bakker, 1974). Whether these early domestic horses were ridden is unknown, because bronze mouth bits and antler cheek pieces from harnesses do not appear until the Late Bronze Age at sites such as Runnymede in Britain (Longley, 1980) and Newgrange in Ireland (Burgess, 1974). Based on the scant osteological evidence, it is not possible to say whether the horses from West Row Fen were wild or domesticated.

Just seven teeth and eight bone fragments were identified as horse. Two of the teeth are deciduous premolars and one cervical is unfused at the caudal epiphyseal plate, representing the remains of at least one immature horse. The other teeth (a worn lower third incisor and a lower third molar) belong to an adult.

The distal epicondyle of an adult horse metapodial was butchered. Multiple transverse cuts on either the medial or lateral surface of this bone are probably indicative of skinning rather than disarticulation, because they are well above the joint. There is no evidence that horses were eaten at West Row Fen, but the single butchered bone suggests that their hides may have been utilized.

Bone and Antler Artifacts

Of the collection of 120 bone and antler artifacts recovered from West Row Fen, 76 are bone awls made from sheep or goat bones. Twelve of these are drilled near the base for sewing or for suspension. A pin, a scoop, and a spatula have also been identified. Ornaments are restricted to three simple, undecorated tubular beads. The most spectacular piece is a well-made and finely polished bone dagger with a tanged handle that may have been a skeuomorph of a more effective bronze weapon.

Many of the artifacts were made from red deer antler, an apparently plentiful and useful raw material. Of the twelve pressure flakers recovered, eight were modified tines, and four were rods cut from antler beams by grooving-and-snapping. A hollow antler handle with two rivet holes and two socketed mace-heads provide clues about how pieces of composite tools were attached to one another. A single antler wedge may have been used in conjunction with an antler mace-head to split wood.

Eighteen pieces of debitage helped decipher manufacturing techniques. These include a split antler (42 cm long) from the soaking pit, a severed antler tine, nine grooved-and-snapped ruminant metapodials, as well as other small indeterminate fragments bearing manufacturing traces.

Conclusions

West Row Fen fits into and generally supports a trend seen in smaller British faunal assemblages from the Neolithic through the Iron Age. During the Early Neolithic (ca. 3500 B.C. to 2750 B.C.), the Windmill Hill culture on the Salisbury Plain depended primarily on cattle (70%), followed by pigs (17%) and sheep/goats (13%) (Ryder, 1983:65). In the Late Neolithic, cattle and pigs occur most frequently in the archaeological record. Sheep and goats were still fairly rare. Cattle began to outnumber pigs in Beaker sites and were prevalent throughout the Bronze Age. From the Early Bronze Age, sheep and goats increased and pigs declined in numbers (Tinsley, with Grigson, 1981). Ryder (1983:72–73) attributes this to the clearing of woodlands.

The Bronze Age of Britain took place during the Subboreal period, which was marked by a decrease in precipitation that reduced productivity in farming and regeneration of forests, but improved conditions for pastoralism in low-lying, poorly drained areas (Ryder, 1983:72–73) such as the fens of East Anglia. This increase in pastoralism is probably responsible for the scarcity of Bronze Age settlement sites in Britain, because nomadism would also have increased. Because of the paucity of large Bronze Age sites, little is known of the relative frequencies of domestic animals and wild game during this period. West Row Fen demonstrates the rise of importance of caprines and the decline of pigs during the Early Bronze Age.

West Row Fen is dominated by cattle in terms of number of bone fragments and estimated meat poundage, but the minimum number of individuals for caprines (sheep/goat) is higher than for cattle (Table 2). Pigs rank third in both numbers of fragments (NISP) and minimum numbers of individuals, but fifth in terms of usable meat. Red deer were the most important wild species, providing as much as a third of the meat at West Row Fen. Their antlers were also employed in the production of a variety of useful artifacts. Roe deer are much smaller and contributed considerably less meat, and their antlers were of little use in tool manufacture.

At Grimes Graves (Fig. 1), in neighboring Norfolk County, the Middle Bronze Age deposits are dominated by cattle, followed closely by caprines, with pigs far behind in third position (Legge, 1992:16–17). However, the ratio of caprines to pigs varies from one region to the next. The Late Bronze Age deposits of Runnymede (Done, 1991) produced slightly more pig than caprine bones, suggesting that fewer forests had been cleared in this area during the Bronze Age. A small collection of bones from Mill Pot Cave, Wetton, Staffordshire, associated with Bronze Age pottery, yielded 76% *Ovis/Capra,* 14% *Bos taurus,* 4% *Sus scrofa,* and 4% *Equus caballus,* based on the minimum numbers of individuals (Ryder et al., 1971).

Most of the Iron Age sites from which there are large faunal assemblages contain predominantly sheep, but these are in downlands that are poorly watered and unsuitable for cattle. There are several Iron Age sites, such as Woodyates, Woodcuts, Longbridge Deverill (phase A), Grimthorpe Hill Fort, and Catcote, where cattle outnumber sheep (Ryder, 1983:79).

West Row Fen, with its three known house structures and large midden, is an important site because Bronze Age settlements of respectable size are rare in Britain, as they are on the continent. The economy of the village, reconstructed from the mammalian remains, implies the degree to which the villagers were sedentary. The possible use of cattle for plowing as well as pulling carts would imply the importance of agriculture relative to herding at West Row Fen. Although pigs rank third in frequency among livestock, their numbers still indicate that the community as a whole was not nomadic (Towne and Wentworth, 1950:69), although shepherds may have left the village seasonally with the caprine herds. The presence of swine suggests that some forests were present, but the greater number of sheep indicates considerable clearing of forests for pasture. Sheep outnumber goats in the fens at this time because of the cool, moist climate of the region and the flat terrain. Red and roe deer are primarily forest dwellers, but their small numbers support the data from sheep that much of the area was cleared for agriculture and grazing. That dogs were eaten is demonstrated by the number of butcher marks on their bones and the treatment of their remains.

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